Physics

PACKAGE II
SENIOR DIVISION

OAIP

Ontario
Assessment
Instrument
Pool

PHYSICS: Package II

SENIOR DIVISION

THE ONTARIO ASSESSMENT INSTRUMENT POOL

This package contains selected response instruments: multiple choice and alternate response instruments. Most of the instruments are suitable for use in evaluating the aims, goals, and objectives of Senior Division Physics. However, some instruments can be used for diagnostic purposes at the Ontario Academic Credit Level. Additional materials will be distributed as they become available.

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TABLE OF CONTENTS

MEASUREMENT

1 5.6×10^{-4}, written as a decimal, is

S17A   (A)   0.000 056
I.1.a
S17C   (B)   0.000 56
I.1.d
            (C)   0.005 6
1
            (D)   0.056
A2
            (E)   0.56

(B)

*
-
**

2   In decimal form, 2.1×10^{4} may be written as

S17A   (A)   0.000 021
I.1.a
S17C   (B)   0.000 21
I.1.d
            (C)   210
1
            (D)   2 100
A4
A2   (E)   21 000

(E)

*
-
*

3   Written in scientific notation (standard form),
                   the measurement 0.004 17 cm is
S17A
I.1.a   (A) 4.17×10^{3} cm
S17C
I.1.d   (B) 417×10^{-5} cm

1   (C) 41.7×10^{-4} cm

A4   (D) 4.17×10^{-3} cm
A2
            (E) 4.17×10^{-2} cm

(D)

*
-
***

4

S17A
I.1.a
S17C
I.1.d

1

A4
A2

(A)

*
-
**

Expressed in scientific notation, 0.000 403 becomes

(A) 4.03×10^{-4}

(B) 4.0×10^{-4}

(C) 0.403×10^{-3}

(D) 0.403×10^{3}

(E) 4.03×10^{4}

5

S17A
I.1.a
S17C
I.1.d

1

A4
A2

(B)

***
-
***

A laser emits red light with a wavelength of 0.000 061 cm. In scientific notation, this wavelength is expressed as

(A) 610×10^{-7} m

(B) 6.1×10^{-7} m

(C) 61×10^{-6} m

(D) 6.1×10^{-5} m

(E) 6.1×10^{5} m

6

S17A
I.1.a
S17C
I.1.d

1

A7
A2

(A)

***
-
***

What is the value of $\dfrac{2.0 \times 10^{-6} \times 5.0 \times 10^{2}}{1.0 \times 10^{5}}$ to the correct number of significant digits?

(A) 1.0×10^{-8}

(B) 10^{-8}

(C) 1

(D) 1.0

(E) 10^{2}

7   When simplified, $\dfrac{10^5}{10^{-3}}$ becomes

S17C
I.1.d   (A) 10^8
S17A
I.1.a   (B) 10^2

                 (C) $10^{-1 \cdot 67}$
S 1
                 (D) 10^{-2}
A4
                 (E) 10^{-8}
(A)

**
–
***

8   What is the correct answer for the following
              calculation?
S17A
I.1.a $\dfrac{8 \times 10^{-6}}{4 \times 10^{-2}}$
S17C
I.1.d   (A) 2×10^{-4}

S1   (B) 2×10^{-8}

A4   (C) 0.5×10^{-4}

(A)   (D) 0.5×10^{-8}

                 (E) 2×10^3

9   How many significant digits does the measurement
              0.005 6 m have?
S17A
I.1.d   (A)   1
S17C
I.1.d   (B)   2

2   (C)   3

A4   (D)   4

(B)   (E)   5

***
–
***

10

S17A
I.1.a
S17C
I.1.d

2

F1

(B)

**

—

***

The measurement 0.003 154 8 m, written in standard form to three significant digits, is

(A) 3.16×10^{-3} m

(B) 3.15×10^{-3} m

(C) 3.15×10^{-2} m

(D)   0.003 m

(E) 3.15×10^{3} m

11

S17A
I.1.a
S17C
I.1

2

F1
A1

(B)

**

—

***

When the number 3.1449 is rounded off to three significant digits, the result is

(A)   3.10

(B)   3.14

(C)   3.15

(D)   3.144

(E)   3.145

12

S17A
I.1.a
S17C
I.1

2

F1
A1

(B)

**

—

***

When the number 3.1449 is rounded off to three significant digits, the result is

(A)   more accurate

(B)   3.14

(C)   3.15

(D)   3.144

(E)   3.145

13 7×10^3 cm is the same length as

S17A   (A) 7×10^2 m
I.1.c
S17C   (B) 7×10^1 m
I.1
               (C)   7 m
S 2
               (D) 7×10^{-1} m
A1
A4   (E) 7×10^{-2} m

 $(\bar{B})$

**
-
***

14   20 m is the same as

S17A   (A) 2.0×10^{-3} km
I.1.c
S17C   (B) 2.0×10^{-2} km
I.1
               (C) 2.0×10^{-1} km
S 2
               (D)   2.0 km
A1
A4   (E) 2.0×10^4 km

 (B)

***
-
***

15   The product of 2.56×10^4 m/s and 3.2×10^3 s
               to the correct number of significant digits is
S17A
I.1.a   (A) 8.19×10^7 m
S17C
I.1   (B) 8.192×10^7 m

3   (C) 8.2×10^7 m

A4   (D) 8.19×10^8 m
A2
               (E) 8.2×10^8 m
 (C)

***
-
***

16

S17A
I.1.d
S17C
I.1.d

3

A4

(D)

***
-
***

The dimensions of a rectangular piece of sheet metal are 20.4 cm and 50.2 cm. Its area, expressed to the correct number of significant digits is

(A) 1×10^3 cm^2

(B) 1.0×10^3 cm^2

(C) 1.1×10^3 cm^2

(D) 1.02×10^3 cm^2

(E) 1.024×10^3 cm^2

17

S17A
I.1.d
S17C
I.1

3

F1

(A)

***
-
***

The length and width of a rectangle are recorded as 11.22 cm and 0.013 cm. The area expressed to the correct number of significant digits is

(A)   0.15 cm^2

(B)   0.145 cm^2

(C)   0.146 cm^2

(D)   0.145 9 cm^2

(E)   0.145 86 cm^2

18

S17A
I.1.a
S17C
I.1

4

A4

(A)

*
-
**

Which one of the following expressions employs correct SI usage?

(A)   5 km

(B)   5 Km

(C)   5 kilometres

(D)   five km

(E)   five Kilometres

19

S17A
I.1.a
S17C
I.1

4

A4

(C)

***
-
***

The power rating of a light bulb is expressed in three different ways:

     I.   100 W

     II. one hundred watts

    III. one hundred W

Which of these expressions conform(s) to correct SI usage?

(A) I only

(B) II only

(C) I and II only

(D) II and III only

(E) I, II and III

20

S17A
I.1.a
S17C
I.1

4

A4

(E)

***
-
***

The distance measurement shown below is expressed in three different ways:

    I   24 kilometres

    II   24 km.

    III 24km

Which of these expressions employ(s) <u>incorrect</u> SI usage?

(A) I only

(B) III only

(C) I and III only

(D) II and III only

(E) I, II and III

21   The quantity 2345.6 g is equal to

S17A   (A)   0.002 345 6 kg
I.1.c
S17C   (B)   2.345 6 kg
I.1
              (C)   23.456 kg
S 4
              (D)   234.56 kg
A1
              (E)   2 345 600 kg
 (B)

*
-
**

22   The prefix 'centi' means

S17A   (A)   100
I.1.a
S17C   (B)   1/10
I.1
              (C)   10
S 4
              (D)   1/100
A1
              (E)   1/1000
 (D)

**
-
***

23   Which one of the following is <u>not</u> a base unit in SI?

S17A   (A)   kelvin
I.1.a
S17C   (B)   kilogram
I.1
              (C)   litre
S 4
              (D)   metre
A1
A2   (E)   second

 (C)

***
-
***

24   The unit of frequency is the

S17A   (A)   hertz
I.1.c
               (B)   joule
S 4
S 46   (C)   pascal
S 341
               (D)   second
A2
               (E)   watt

 (A)

*
-
*

25   Which one of the following is <u>not</u> a metric prefix?

S17A   (A)   kilo
I.1.c
S17C   (B)   macro
I.1
               (C)   mega
S 4
               (D)   micro
A4
               (E)   nano
(B)

*
-
*

1   The kilogram is a unit of measurement.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

S 4

A1
A2

(A)

2   The metre is a unit of measurement.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

S 4

A1
A2

(A)

*
—
*

FUNCTIONS

1

S17A
I.2.a
S17C
I.2.b

10

A11
A2
A6

(A)

**
-
***

The graph below indicates a linear relationship
between v and t.

(A)   True

(B)   False

2

S17A
I.2.a
S17C
I.2.b

11

A2
A11

(A)

**
-
**
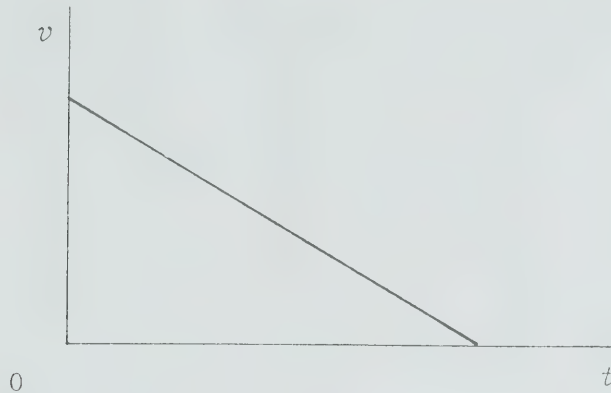
If two quantities A and B are related such that

$\frac{A}{B} = k$, where k is constant, then A is directly

proportional to B.

(A)   True

(B)   False

3

S17A
I.2.a
S17C
I.2.b

11

A11
A5

(B)

***

-

***

One conclusion that can be correctly drawn from the graph below is that $AB = k$, where k is constant.

(A)   True

(B)   False

4

S17A
I.2.a
S17C
I.2.b

11

A11
A5

(B)

**

-

**
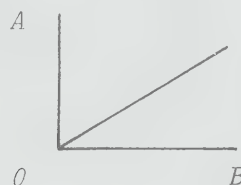
The graph below correctly indicates that $a \propto \dfrac{1}{t}$.

(A)   True

(B)   False

5

S17A
I.2.b

12

A2
A4

(B)

***

-

***
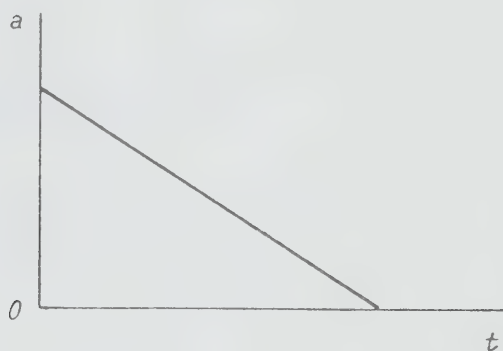
If two quantities A and B vary inversely with each other, then the ratio $\dfrac{A}{B}$ is constant.

(A)   True

(B)   False

6

S17C
I.2.c

13

D4

(D)

*
–
*

The graph illustrates the relationship between two variables Q and F.
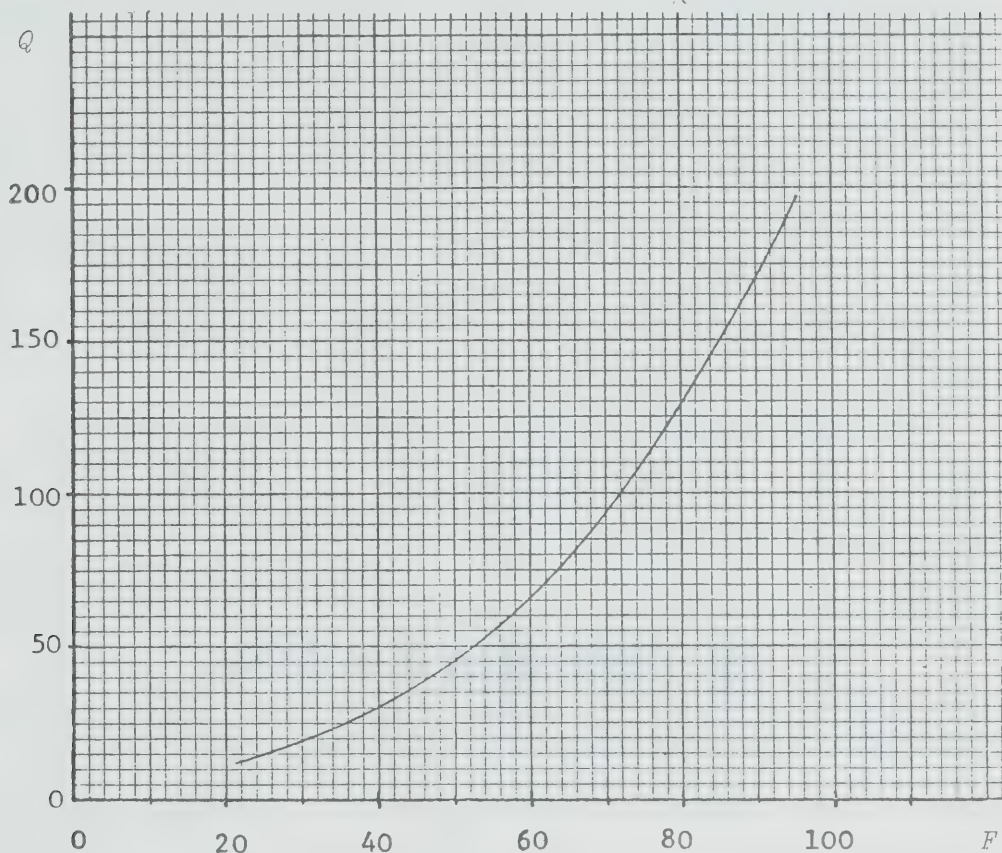
The value of Q when $F = 80$ is most nearly

(A)   63

(B)   66

(C)   115

(D)   130

(E)   150

KINEMATICS

MOTION IN A STRAIGHT

LINE

1

S17A
I.2.a
S17C
I.3.d

14

F1
D1
D2
D3

(C)

**
-
**

The tape from a laboratory experiment using a bell clapper has the appearance shown below.
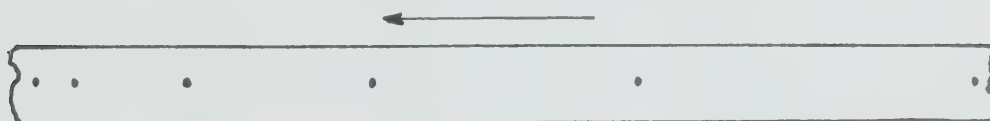
Which one of the following graphs could be the distance-time graph for an object moving to the left?

(A)   (B)   (C)

(D)   (E)

2

S17A
I.2.a
S17C
I.3

S 14

A3

(D)

***
-
**
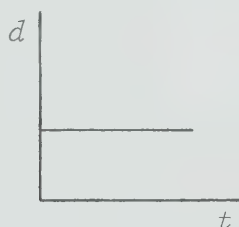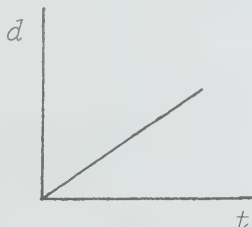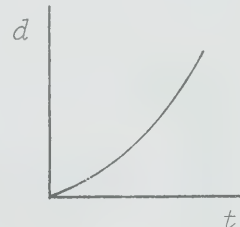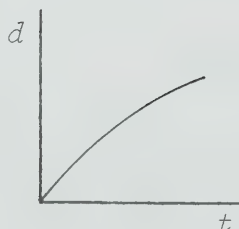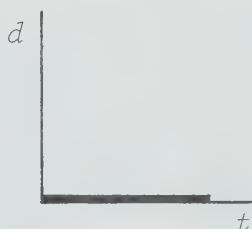
If object A is in motion relative to object B, then
B must be

(A)   at rest relative to the earth

(B)   in motion relative to the earth

(C)   at rest relative to A

(D)   in motion relative to A

(E)   in motion relative to the earth and A

3

S17A
I.2.a
S17C
I.3.b

S 14
S 17

A11

(E)

***
-
***

An object's motion is represented by the following
graph.
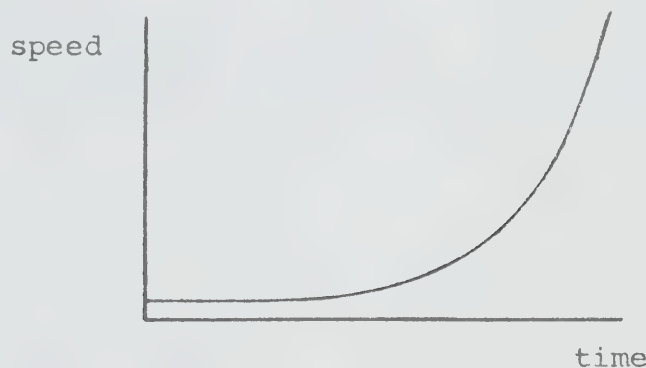
Which of the following statements describes the
motion of the object for the time duration shown?

The object is

(A)   moving at constant speed

(B)   stationary for half the time

(C)   moving with uniformly increasing speed

(D)   moving with constant acceleration

(E)   moving in some other way than described in
(A), (B), (C), or (D)

4

S17A
I.2.a
S17C
I.3.a

S 14

D3

(C)

*
-
*

Which graph below represents the motion of an object at rest?

(A)

(B)

(C)

(D)

(E)

5

S17A
I.2.a
S17C
I.3.a

S 14

D3

(C)

*
-
*

Which graph below represents the motion of an object at rest?

(A)

(B)

(C)

(D)

(E)

6

S17A
I.2.a
S17C
I.3.a

15

A2

(B)

**

-

***
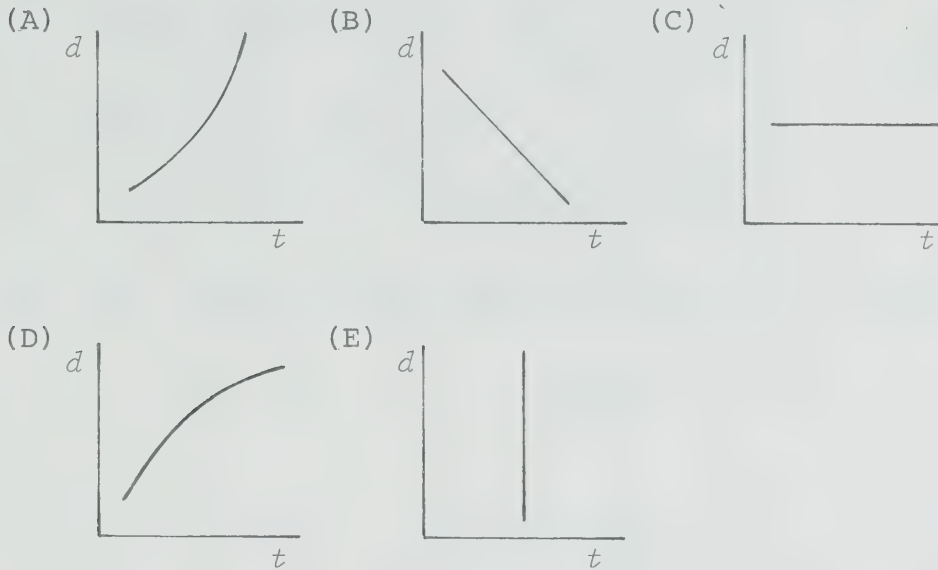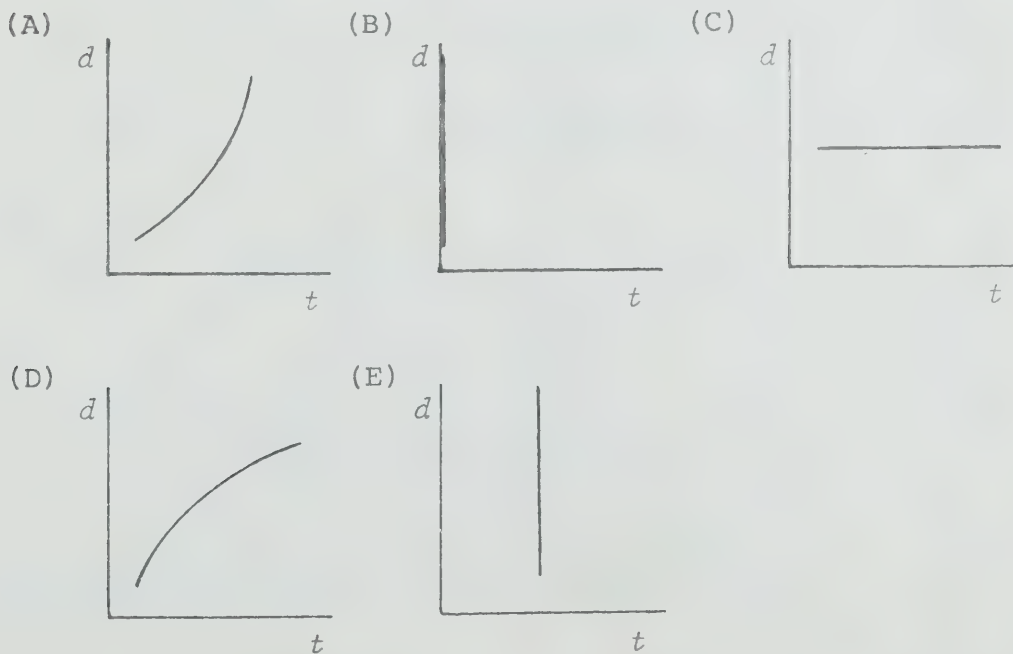
Which of the following examples does not illustrate uniform motion?

(A)   A ball rolls along a table without changing velocity.

(B)   A mass is thrown vertically upward at 10 m/s.

(C)   A jogger runs 50 m along a straight track at constant speed.

(D)   An elevator moves vertically upward past four floors at zero acceleration.

(E)   An elevator sits at rest between two floors, where $g = 10$ N/kg.

7

S17A
I.2.a
S17C
I.3.a

15

A11

(C)

***

-

***

This displacement-time graph for an object moving along a straight line illustrates

(A)   zero velocity

(B)   increasing velocity

(C)   zero acceleration

(D)   positive constant acceleration

(E)   increasing acceleration

8

S17A
I.2.a
S17C
I.3.a

S 15

A2

(C)

***

-

***
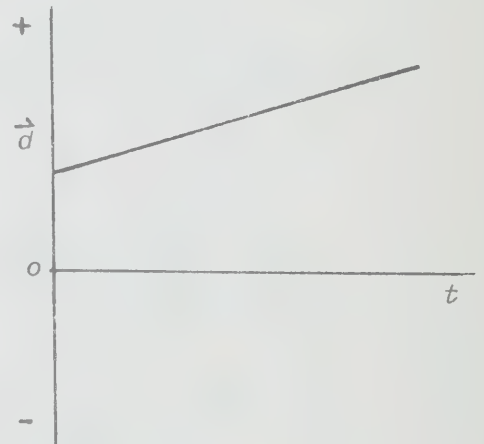
An object has uniform motion if

(A)   its speed is constant

(B)   it travels in a straight line

(C)   its velocity is constant

(D)   its acceleration is constant

(E)   it travels in a circle at constant speed

9   Which of the following motions is uniform?

S17A   (A)   a child on a merry-go-round travelling at
I.2.a   constant speed
S17C
I.3.a   (B)   a parachutist falling vertically at constant
                      speed
S 15
                (C)   a satellite in orbit around the earth
A2
                (D)   a soccer ball rolling on a grass field
(B)
                (E)   an object accelerating at 10 m/s^2 every second
***
-
***

10   Which graph represents the motion of an object moving
               with a constant, non-zero speed?
S17A
I.2.a   (A)   (B)   (C)
S17C
I.3.a

S 15

D3

(B)

***
-            (D)   (E)
***

11

S17A
I.2.a
S17C
I.3.a

S 15

F1
A3

(D)

*

\-

*
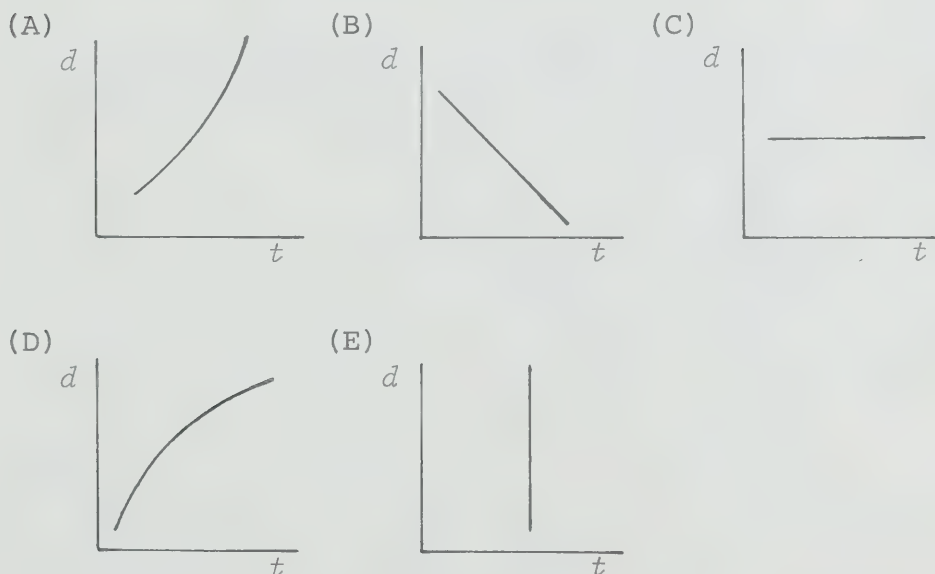
A runner travels 60 m at a steady speed of 5.0 m/s.
The time taken is

(A)   0.080 s

(B)   3.0 s

(C)   6.0 s

(D)   12 s

(E) 3.0×10^2 s

12

S17A
I.2.a
S17C
I.3.a

S 15

F1
A3

(C)

*

\-

*

To cover a distance of 40 m at a constant speed of
5.0 m/s requires a time of

(A) 1.3×10^{-1} s

(B) 8.0×10^{-1} s

(C)   8.0 s

(D) 2.0×10^1 s

(E) 2.0×10^2 s

13

Which graph represents the motion of an object increasing in speed?

(A)

(B)

(C)

(D)

(E)
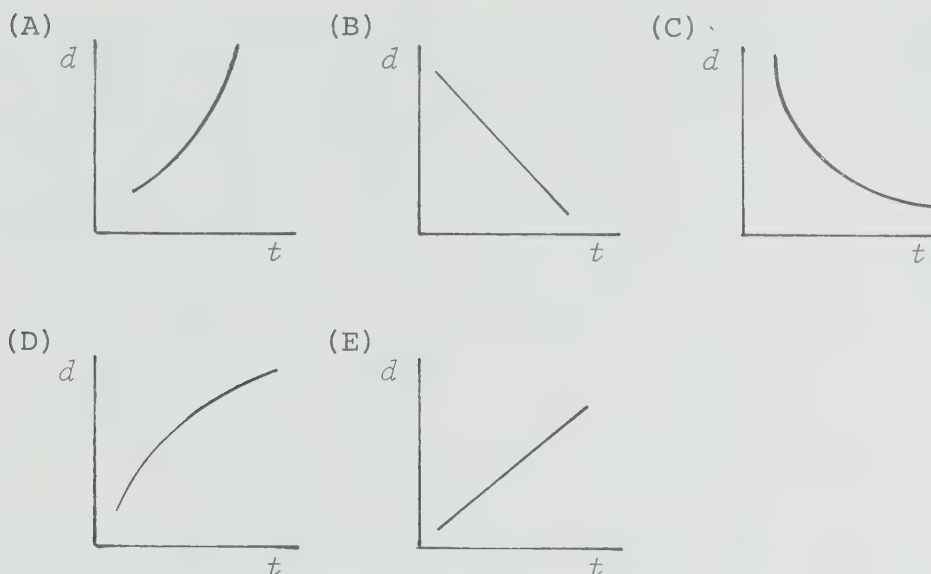
14

Which graph represents the motion of an object decreasing in speed?

(A)

(B)

(C)

(D)

(E)
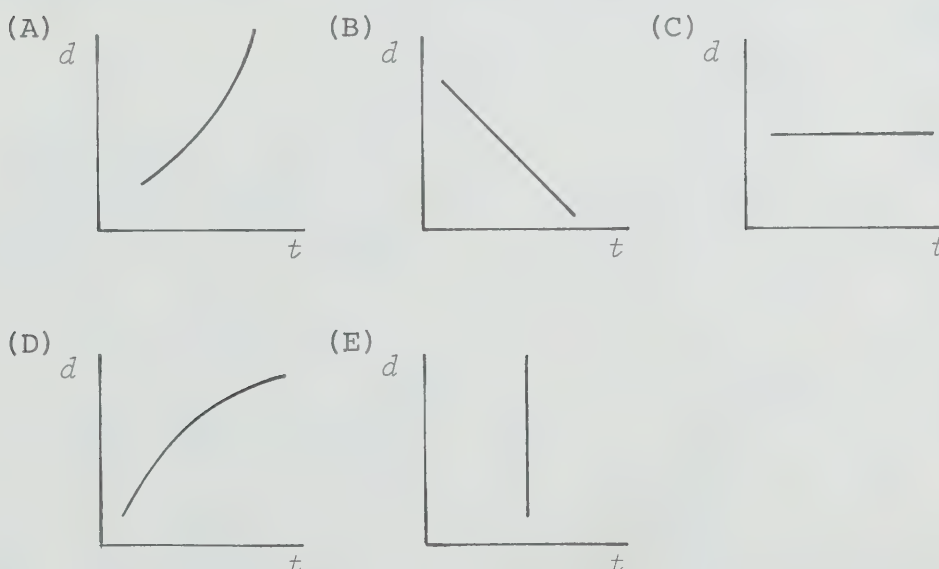
15

Which distance-time graph represents an impossible situation?

(A) d vs t (B) d vs t (C) d vs t

(D) d vs t (E) d vs t
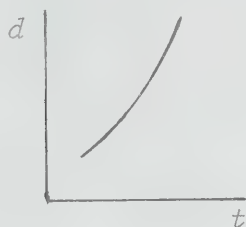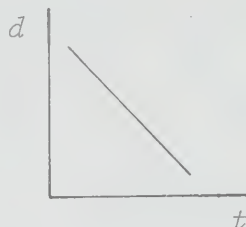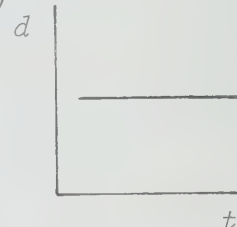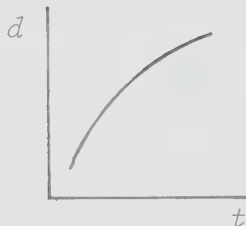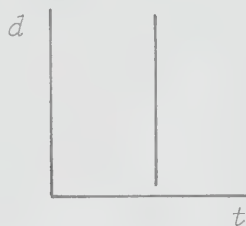
16

Which one of the following graphs would be the distance-time graph for an object falling freely from the top of a tower?

(A) d vs t (B) d vs t (C) d vs t

(D) d vs t (E) d vs t
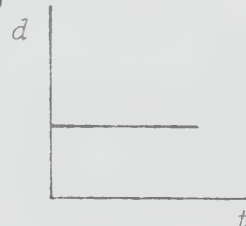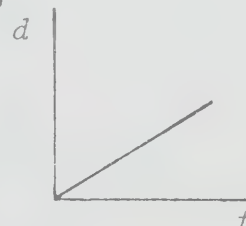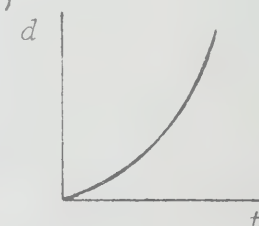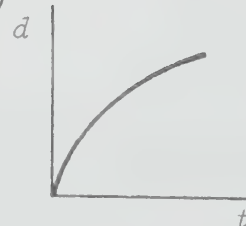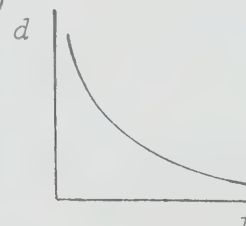
17   Consider the following graph.

S17A
I.2.a
S17C
I.3.a

S 16

D3

(B)

**

-

***
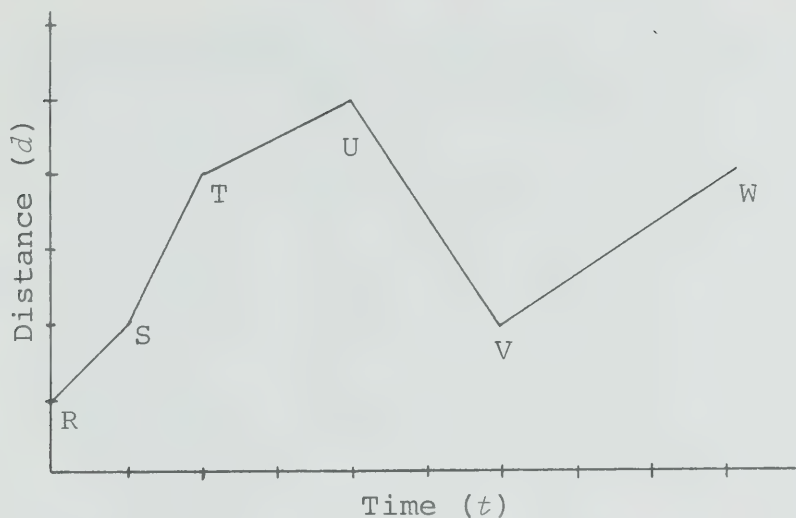
The average speed is greatest during interval

(A)   RS

(B)   ST

(C)   TU

(D)   UV

(E)   VW

18   Which one of the following
                statements correctly
S17A   describes the motion of an
I.2.a   object depicted by the
S17C   graph?
I.3.a

                (A)   The object has
S 16   non-uniform motion.

D3   (B)   The object has
                      constant velocity.
(B)
                (C)   The object has increasing velocity.
**
-               (D)   The object has constant non-zero acceleration.
**
                (E)   The object has increasing acceleration.
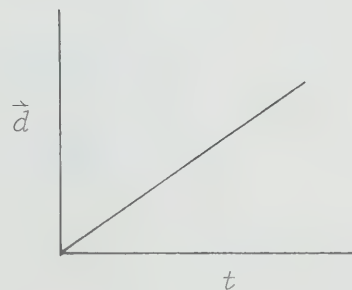
19   The following graph shows the motion of an auto-
mobile during a 7 h period.

S17A
I.2.a
S17C
I.3.a

S 16

F1
A7

(D)

**

-

***

Time (h)
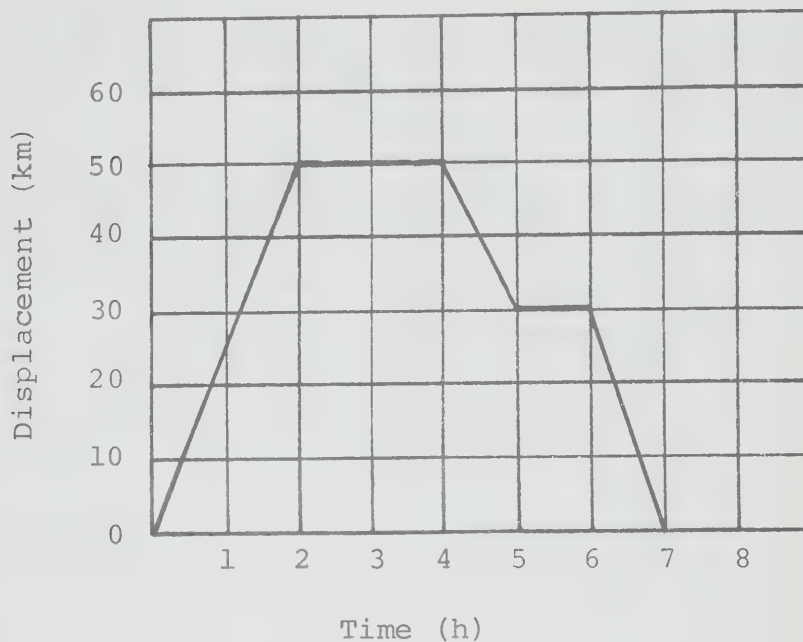
Which of the following statements is <u>false</u>?

(A)   The car returned to its starting point after
7 h.

(B)   The total distance travelled by the car was
100 km.

(C)   The car's motion was uniform during the first
2 h.

(D)   The car was moving at all times during the 7 h
period.

(E)   The car did not change direction between 4 h
and 7 h.

20

S17A
I.2.a
S17C
I.3.b

17

A11

(E)

***
–
***

Shown below is the velocity-time graph for an object during a 10 s time interval.
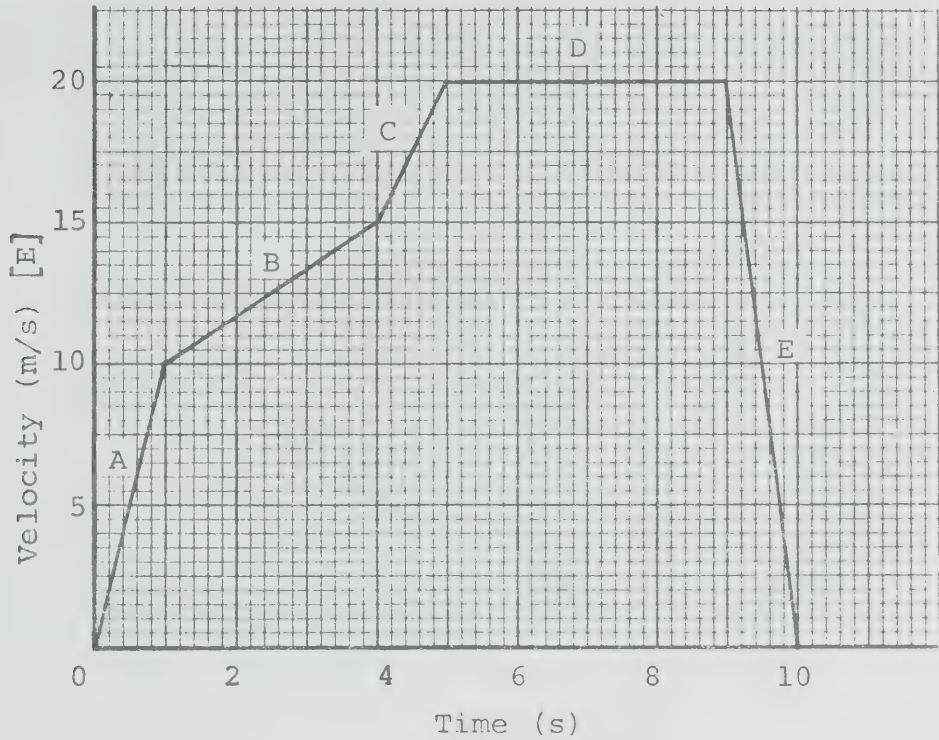
Which segment of the graph shows the greatest magnitude of acceleration?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

21   Shown below is the velocity-time graph for an object
            during a 10 s time interval.

S17A
I.2.a
S17C
I.3.b

17

A11

(D)

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-
***
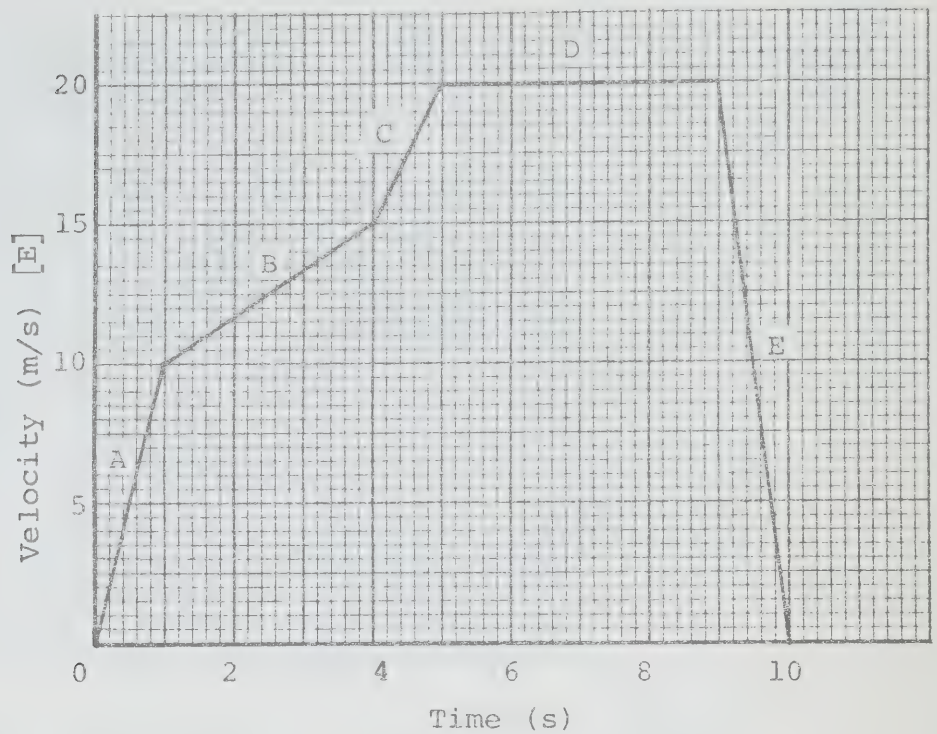
Which segment of the graph shows the smallest
magnitude of acceleration?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

22

Shown below is the velocity-time graph for an
object during a 10 s time interval.
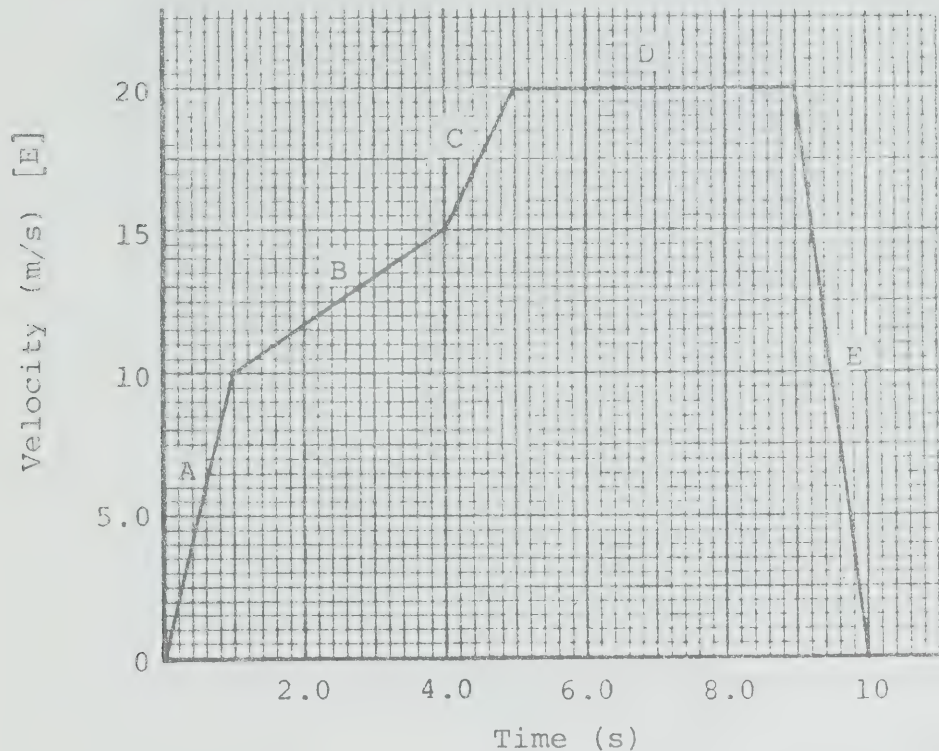
What is the acceleration of the object during
segment B?

(A)   0.60 m/s^2 [E]

(B)   1.7 m/s^2 [E]

(C)   2.5 m/s^2 [E]

(D)   5.0 m/s^2 [E]

(E)   15 m/s^2 [E]

23   Which of the following is <u>not</u> an acceleration unit?

S17A   (A) m/s^2
I.2.a
S17C   (B) $(km/h)/s$
I.3.b
              (C) $(m/s)/s$
S 17
              (D) km/s
A4
A2   (E) $(km/h)/h$

(D)

**

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***

24   Which one of the following units can <u>not</u> be used to
              measure acceleration?
S17A
I.2.a   (A) cm/s^2
S17C
I.3.b   (B) $(km/h)/s$

S 17   (C) m/s^2

A4   (D) mm/s
A2
              (E) $(m/s)/h$
(D)

**

–

***

25

Shown below is the velocity-time graph for an object during a 10 s time interval.

S17A
I.2.a
S17C
I.3.b

S 17

A11
A1

(D)

**

-

***
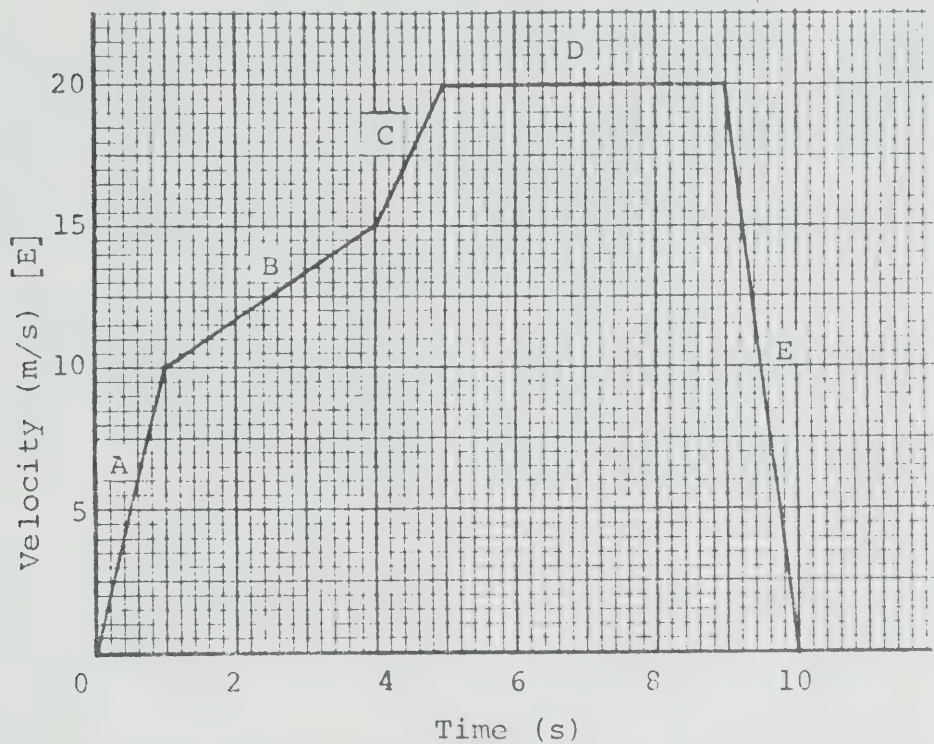
Which segment of the graph shows the greatest average velocity?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

26

S17A
I.2.a
S17C
I.3.b

S 17

D3
A2

(B)

**

–
**

Which one of the following statements correctly describes the motion of an object depicted by the graph?
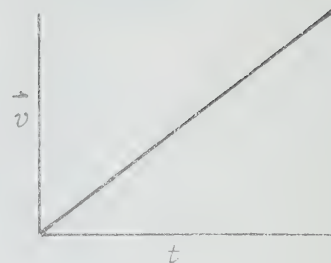
(A) The object is in uniform motion.

(B) The object is accelerating uniformly.

(C) The object is moving to the right.

(D) The object is moving at constant velocity.

(E) The object is at rest.

27   Which graph does not represent constant velocity?

S17A
I.2.a
S17C
I.3.a.b

S 17
S 16

D3
A11
A2

(C)

**

–
***
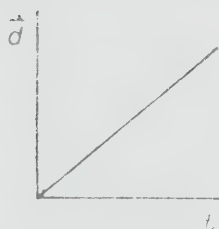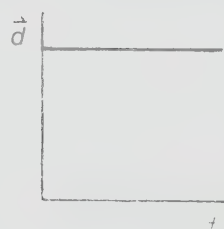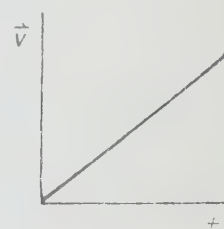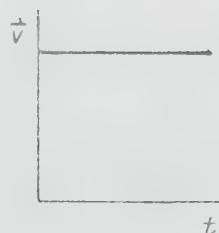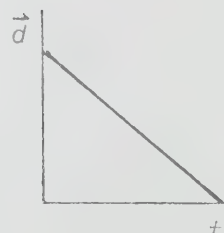
28

The graph below shows the motion of a bicycle during a period of 10 s.

S17A
I.2.a
S17C
I.3.b

S 17

D3
A11
A2

(C)

***
–
***
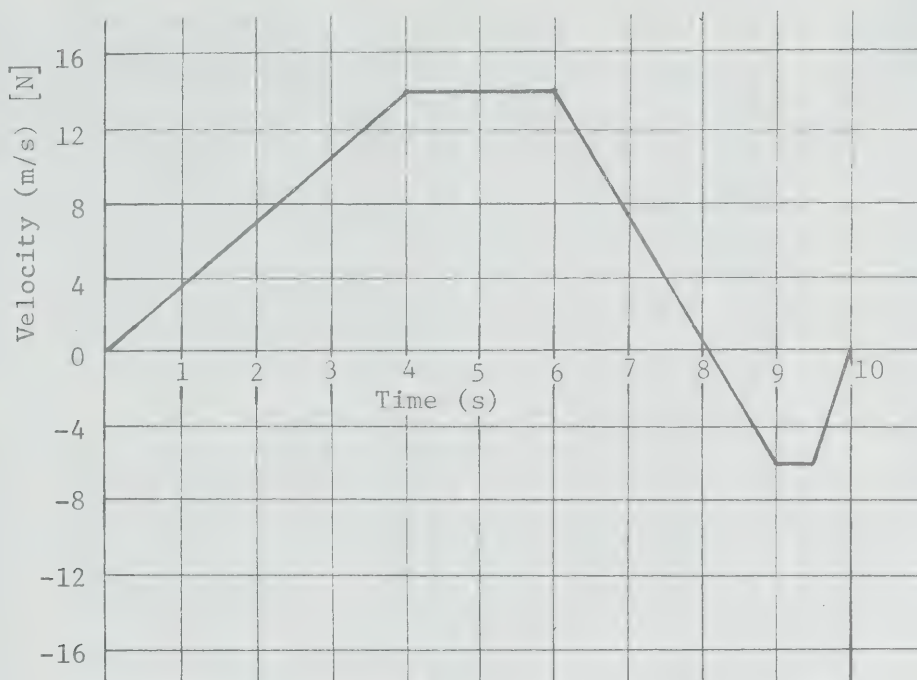
During the time interval 6 s to 8 s, the bike is

(A)   moving north at an increasing speed

(B)   moving south at an increasing speed

(C)   moving north at a decreasing speed

(D)   moving south at a decreasing speed

(E)   moving north at a decreasing speed then south at an increasing speed

29

S17A
I.2.a
S17C
I.3.b

S 17

D3
A11
A2

(B)

**
-
**

The graph below shows the motion of a bicycle during a period of 10 s.
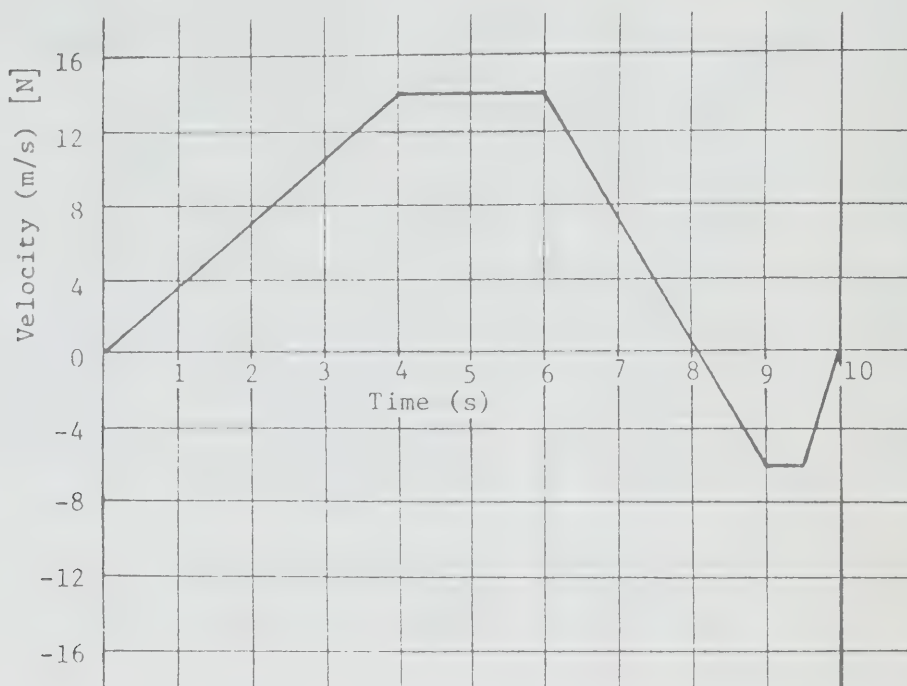
During the time interval 0 to 4 s, the bicycle is

(A)   travelling north at constant speed

(B)   travelling north at an increasing speed

(C)   travelling north at a decreasing speed

(D)   travelling south at an increasing speed

(E)   travelling north at a constant velocity

30   "Acceleration is the rate of change of velocity
                 with time."
S17A
I.2.a   The above statement is
S17C
I.3.b   (A)   an observation

S 17   (B)   a definition

I1   (C)   a scientific model
A2
                (D)   a scientific law
(B)
                (E)   a scientific theory
**
−
**

31   The area under a velocity-time graph represents

S17A   (A)   acceleration
I.2.a
S17C   (B)   change in acceleration
I.3.b
                (C)   speed
18
                (D)   change in velocity
A1
A7   (E)   displacement

(E)

***
−
***

32   Displacement can be obtained from

S17A   (A)   the slope of an acceleration-time graph
I.2.a
S17C   (B)   the slope of a velocity-time graph
I.3.b
                (C)   the area under an acceleration-time graph
18
                (D)   the area under a velocity-time graph
A7
A2   (E)   the slope of a displacement-time graph

(D)

***
−
***

33

S17A
I.2.a
S17C
I.3.b

18

A11
A7

(C)

***
–
***

Shown below is the velocity-time graph for an object during a 10.0 s time interval.
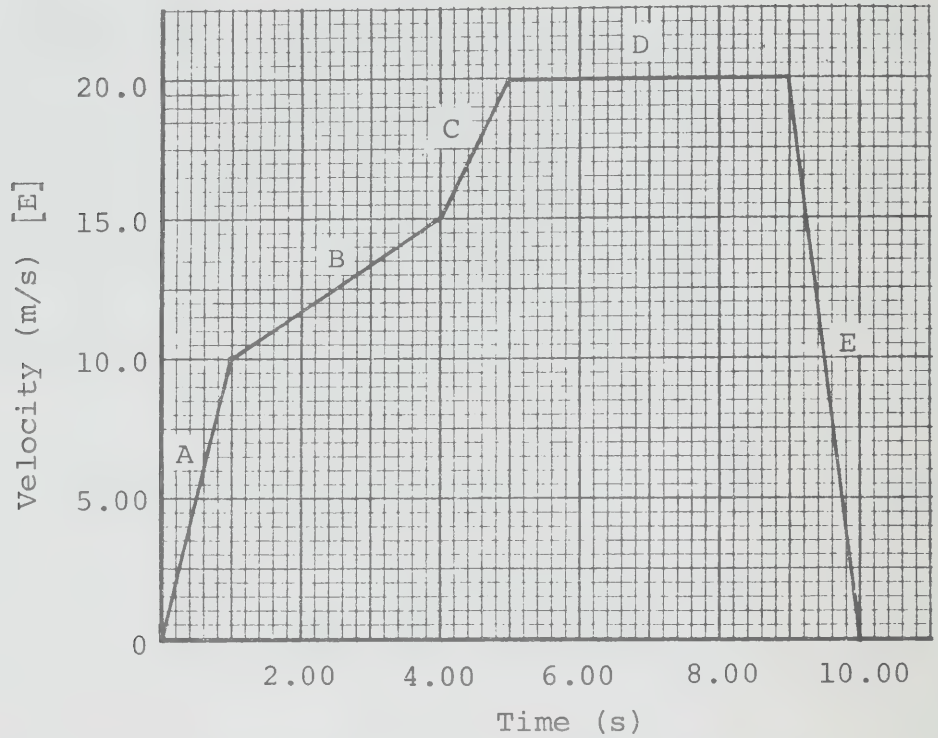
How far did the object travel during segment B?

(A)   7.50 m

(B)   30.0 m

(C)   37.5 m

(D)   45.0 m

(E)   50.0 m

34

S17A
I.2.a
S17C
I.3.c

S 18

A7
A1
A2

(C)

***
-
***

The area under a velocity-time graph gives the

(A)   time taken for the motion

(B)   average velocity

(C)   displacement

(D)   acceleration

(E)   average speed

35

S17A
I.2.a
S17C
I.3.b

19

F1

(C)

**
-
**

A car accelerates uniformly from 3.5 m/s to 12.5 m/s
in 4.5 s. The magnitude of the acceleration is

(A) 0.28 m/s^2

(B) 0.50 m/s^2

(C) 2.0 m/s^2

(D) 3.6 m/s^2

(E) 9.7 m/s^2

36

S17A
I.2.a
S17C
I.3.c

19

F1

(D)

*
-
**

A rock is dropped from a tall building where
$g = 10 \text{ m/s}^2$. After falling for three seconds
its speed will be closest to

(A)   3.0 m/s

(B)   10 m/s

(C)   13 m/s

(D)   30 m/s

(E)   45 m/s

37

S17A
I.2.a
S17C
I.3.b

19

F1

(E)

*
–
**

If a car starts from rest and accelerates at a rate
of 4.0 m/s^2 [E] for 20 s, what is the final velocity
of the car?

(A)   4.0 m/s [E]

(B)   5.0 m/s [E]

(C)   16 m/s [E]

(D)   24 m/s [E]

(E)   80 m/s [E]

38

S17A
I.2.b
S17C
I.3.c

19

F1

(E)

***
–
***

A speedboat, travelling north, slows down from a
speed of 25 m/s to 10 m/s in a time of 5.0 s. Its
average acceleration is

(A)   15 m/s^2 north

(B)   15 m/s^2 south

(C)   7.0 m/s^2 south

(D)   3.0 m/s^2 north

(E)   3.0 m/s^2 south

39

S17A
I.2.b
S17C
I.3.c

19

F1

(D)

**
–
**

A car travelling on the highway at 15 m/s accelerates
at 3.0 m/s^2 for 5.0 s. What is its final speed?

(A)   18 m/s

(B)   20 m/s

(C)   23 m/s

(D)   30 m/s

(E)   45 m/s

40

S17A
I.2.b
S17C
I.3.c

19

F1

(E)

**

\-

***

A runner increases speed on a straight track from
3.0 m/s to 7.0 m/s in 2.0 s. The magnitude of the
average acceleration is

(A)   20 m/s^2

(B)   8.0 m/s^2

(C)   5.0 m/s^2

(D)   4.0 m/s^2

(E)   2.0 m/s^2

41

S17A
I.2.b
S17C
I.3.c

19

F1

(D)

**

\-

***

In 6.0 s the speed of a subway train changes from
48 m/s to 12 m/s. The acceleration is

(A)   6.0 m/s

(B)   -6.0 m/s

(C)   6.0 m/s^2

(D)   -6.0 m/s^2

(E)   -36 m/s

42

S17A
I.2.a
S17C
I.3.c

21

F1

(D)

**

\-

***

A heavy ball is thrown straight down from a tower
with an initial speed of 50 m/s. ($g = 10$ m/s^2)
After 2.0 s its speed is

(A)   2.5 m/s

(B)   30 m/s

(C)   62 m/s

(D)   70 m/s

(E)   1.1 x 10^2 m/s

43

S17A
I.2.a
S17C
I.3.c

21

F1
A3

(B)

A car travelling east at 40 m/s came to rest in 8.0 s after the brakes were applied. The average acceleration of the car during the 8.0 s interval was

(A)   5.0 m/s^2 east

(B)   5.0 m/s^2 west

(C)   2.5 m/s^2 east

(D)   2.5 m/s^2 west

(E)   0.20 m/s^2 west

***
-
***

44

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(A)

An object starting from rest has an acceleration of 8.0 m/s^2. After 10 s its speed is

(A)   80 m/s

(B)   80 m/s^2

(C)   1.3 m/s

(D)   0.80 m/s

(E)   0.80 m/s^2

**
-
***

45

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(E)

A 5.0 kg sphere initially at rest is allowed to fall toward the earth for a time of 5.0 s. (g = 10 m/s^2) Its velocity at the end of this time is

(A)   10 m/s down

(B)   20 m/s down

(C)   30 m/s down

(D)   40 m/s down

(E)   50 m/s down

**
-
**

46

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(B)

**
-
**

An object moving with uniform acceleration changes its speed from 25 m/s to 45 m/s in 5.0 s.   Its acceleration is

(A)   4.0 m/s

(B)   4.0 m/s^2

(C)   9.0 m/s^2

(D)   14 m/s

(E)   14 m/s^2

47

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(E)

**
-
**

A stone initially at rest falls toward the earth for 6.0 s.   If $g = 10$ m/s^2, the final speed of the stone is

(A)   1.6 m/s

(B)   6.0 m/s

(C)   10 m/s

(D)   10 m/s^2

(E)   60 m/s

48

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(E)

***
-
***

An athlete completes two laps of a circular track of radius 50.0 m.   The total distance the athlete runs is

(A)   0

(B)   50.0 m

(C)   100 m

(D)   314 m

(E)   628 m

49

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(A)

**
-
***

A hockey player, gliding along the ice at a speed of 1 m/s, accelerates at 2 m/s^2 for 3 s. His final speed is

(A)   7 m/s

(B)   6 m/s

(C)   5 m/s

(D)   3 m/s

(E)   2 m/s

50

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(C)

*
-
*

A car starts from Hither, goes to Yon, and returns. The round trip distance of 100 km takes 2.00 h. The average speed for the round trip is

(A)   0

(B)   0.0200 km/h

(C)   50.0 km/h

(D)   100 km/h

(E)   200 km/h

51

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(A)

A car starts from Hither, goes to Yon, and returns. The round trip distance of 100 km takes 2.0 h. The magnitude of the average velocity for the round trip is

(A)   0

(B)   5.0 x 10^1 km/h

(C)   1.0 x 10^2 km/h

(D)   2.0 x 10^2 km/h

(E)   2.0 x 10^{-2} km/h

52

S17A
I.2.a
S17C
I.2.c

21

F1
A8

(C)

*
-
**

An object that changes its velocity by 28.0 m/s $[N]$ in a time of 4.00 s has an average acceleration of

(A)   1.75 m/s^2 $[N]$

(B)   3.50 m/s^2 $[N]$

(C)   7.00 m/s^2 $[N]$

(D)   24.0 m/s^2 $[N]$

(E)   112 m/s^2 $[N]$

53

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(C)

*
-
**

A plane starting from rest accelerates at a rate of 1.5 m/s^2 for 40 s before taking off. The take-off speed is

(A)   40 m/s

(B)   50 m/s

(C)   60 m/s

(D)   70 m/s

(E)   1.2 x 10^2 m/s

54

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(A)

**
-
***

An object travels a distance of 6.0 x 10^3 m with a uniform speed of 1.5 x 10^4 m/s. The time it takes is:

(A)   4.0 x 10^{-1} s

(B)   2.5 s

(C)   4.0 x 10^1 s

(D)   4.0 x 10^7 s

(E)   9.0 x 10^7 s

55

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(B)

*
–
**

A sports car increases its speed along a straight road from 20 km/h to 50 km/h in a time of 5.0 s. The magnitude of the acceleration of the car is

(A)   3.0 (km/h)/s

(B)   6.0 (km/h)/s

(C)   7.0 (km/h)/s

(D)   10 (km/h)/s

(E)   14 (km/h)/s

56

S17A
I.2.a
S17C
I.3.c

21

F1
A8

(C)

*
–
***

The velocity of a car moving at 20 m/s changes to 60 m/s in 10 s. The average acceleration is

(A)   40 m/s^2

(B)   8.0 m/s^2

(C)   4.0 m/s^2

(D)   3.0 m/s^2

(E)   −4.0 m/s^2

57

S17A
I.2.a
S17C
III.2.a

S 21

A1

(B)

***
–
***

A baseball is thrown vertically into the air. The instantaneous acceleration of the ball at the highest point in its travel is

(A)   10 m/s^2 up

(B)   10 m/s^2 down

(C)   changing from 10 m/s^2 up to 10 m/s^2 down

(D)   changing from 10 m/s^2 up to zero to 10 m/s^2 down

(E)   zero

58

S17A
I.2.a
S17C
III.2.a

S 21

A1

(D)

**
-
***

The acceleration due to gravity on earth is approximately

(A)   1.0 km/s^2

(B)   1.6 m/s^2

(C)   10 m/s

(D)   10 m/s^2

(E)   60 m/s^2

59

S17A
I.2.a
S17C
I.3.b

S 21

A11
A4

(B)

***
-
***

If a physical quantity were defined as the rate of change of velocity with distance travelled, the SI unit for the quantity would be

(A)   m/s

(B) $\dfrac{m/s}{m}$

(C)   m/s^2

(D) $\dfrac{m^2}{s}$

(E) $\dfrac{s}{m^2}$

60

S17A
I.2.a
S17C
I.3.c

S 21

F1

(B)

***
-
***

A one kilogram object falls to earth from a height of 20 m.   ($g = 10$ m/s^2)

Just before it hits the ground its speed is

(A)   6.3 m/s

(B)   20 m/s

(C)   40 m/s

(D) 2.0×10^2 m/s

(E) 4.0×10^2 m/s

61

S17A
I.2.a
S17C
I.3.c

S 21

F1
A2

(A)

***
-
***

A square race track has each side 100 m long. A jogger at the southeast corner starts running northward and runs once around the track in 50 s. The jogger's average velocity is

(A)   zero

(B)   1.0 m/s $[W]$

(C)   2.0 m/s $[W]$

(D)   4.0 m/s $[W]$

(E)   8.0 m/s $[W]$

62

S17A
I.2.a
S17C
I.3.c

S 21

F1
A3

(C)

A feather at rest in a vacuum is released from a height of 10 m above the earth's surface. Which one of the following statements about the motion is correct?

(A)   The maximum velocity of the feather is 10 m/s down.

(B)   The acceleration of the feather decreases until the terminal velocity is reached.

(C)   The acceleration of the feather remains constant throughout the fall.

(D)   The acceleration of the feather increases throughout the fall.

(E)   The acceleration of the feather remains at zero throughout the fall.

63

S17A
I.2.a
S17C
I.3.c

S 21

F1
A3

(C)

*
-
*

An airplane covers 600 km in 2.00 h. Its average speed is

(A) 3.33×10^{-3} km/h

(B)   3.00 km/h

(C) 3.00×10^{2} km/h

(D) 6.02×10^{2} km/h

(E) 1.20×10^{3} km/h

64

S17A
I.2.a
S17C
I.3.c

S 21

F1
A8

(C)

*
-
*

Travelling at a constant speed of 12 m/s for a distance of 132 m requires a time of

(A) 9.1×10^{-2} s

(B) 9.1×10^{-1} s

(C) 1.1×10^{1} s

(D) 1.1×10^{2} s

(E) 1.6×10^{3} s

65

S17A
I.2.a
S17C
I.3.c

S 21

F1
A8

(B)

***
-
***

A car travelled up a hill at a constant speed of 10.0 km/h and returned down the hill at a speed of 20.0 km/h. If the time needed to turn around is ignored, what was the average speed for the total trip?

(A)   0

(B)   13.3 km/h

(C)   15.0 km/h

(D)   16.7 km/h

(E)   There is not enough information is answer the question.

1   If a body initially at rest accelerates uniformly,
               then the distance it travels varies directly as the
S17A   square of the time elapsed.
I.2.a
S17C   (A)   True
I.3.a
               (B)   False
14

A3
A8

(A)

***
-
***

2   If a body travels at constant speed, then the
               distance it travels varies directly as the time
S17A   elapsed.
I.2.a
S17C   (A)   True
I.3.a
               (B)   False
15

A3
A8

(A)

*
-
**

3   Displacement is a unit of measurement.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

S 15

A1
A2

(B)

4

S17A
I.2.a
S17C
I.3.a

S 15

D3
A11

(A)

**

—

**

The graph below depicts the motion of an object at rest.

$\vec{d}$

t

(A)   True

(B)   False

5

S17A
I.2.a
S17C
I.3.a

S 15

D3
A11

(B)

**

—

**
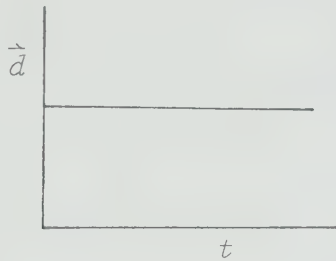
The graph below depicts an object moving at constant velocity.
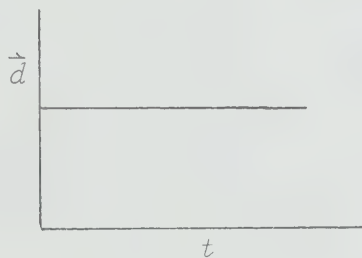
$\vec{d}$

t

(A)   True

(B)   False

6

S17A
I.2.a
S17C
I.3.a

16

A11

(A)

***

—

***

This graph represents motion at constant speed.

(A)   True

(B)   False

d

0 t
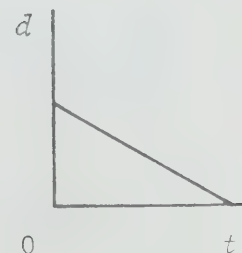
7   This graph represents motion
               at constant speed.
S17A
I.2.a   (A)   True
S17C
I.3.a   (B)   False

16

All

(A)

**
-
**

8   This graph represents motion
               at constant speed.
S17A
I.2.a   (A)   True
S17C
I.3.a   (B)   False

16

All

(B)
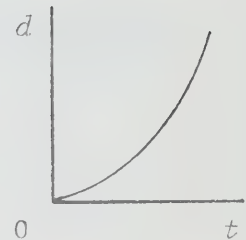
*
-
*

9   This graph represents motion
               at constant non-zero
S17A   acceleration.
I.2.a
S17C   (A)   True
I.2.a
               (B)   False
16

All

(B)

***
-
***

10
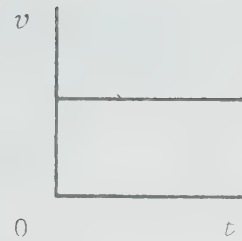
S17A
I.2.a
S17C
I.3.a

17

A11

(A)

*
-
**

This graph represents motion
at constant speed.

(A)   True

(B)   False

11

S17A
I.2.a
S17C
I.3.b

17

A11

(A)

**
-
**

This graph represents motion
at constant non-zero
acceleration.

(A)   True

(B)   False

12

S17A
I.2.a
S17C
I.3.b

17

A11
A3

(A)

**

–

**
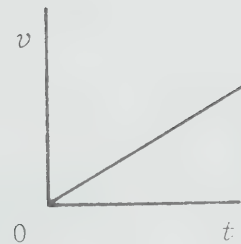
In the graph below, the change in velocity occurring in any time period between t_1 and t_2 varies directly with the size of the time interval considered.

(A) True

(B) False

13

S17A
I.2.a
S17C
I.3.c

19

A2
A8

(B)

***

–

***
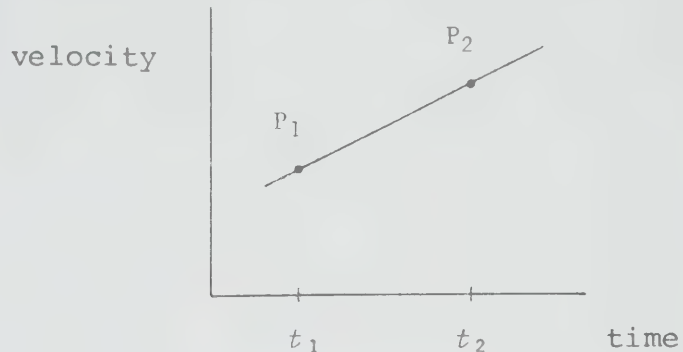
If a body has an instantaneous acceleration of +5 m/s^2, it <u>must</u> be moving.

(A) True

(B) False

14

S17A
I.2.a
S17C
I.3.c

19

A3

(A)

**
—
***

A body can have a velocity directed east and an acceleration directed west at the same time.

(A)   True

(B)   False

15

S17A
I.2.a
S17C
I.3.c

19

A3
A8

(B)

**
—
**

If a body has an acceleration of -3 m/s^2, it <u>must</u> be moving in a negative direction.

(A)   True

(B)   False

16

S17A
I.2.a
S17C
I.3.c

20

A8
A2

(B)

**
—
***

The displacement of an object travelling at constant acceleration along a straight line depends <u>only</u> on the values of the initial and the final velocities.

(A)   True

(B)   False

17   If the acceleration of an object is zero, its
            velocity <u>must</u> be constant.

S17A
I.2.a   (A)   True
S17C
I.3.b   (B)   False

21

A8
A2

(A)

*
—
***

18   If the acceleration of an object is zero, its
            velocity <u>must</u> be constantly changing.

S17A
I.2.a   (A)   True
S17C
I.3.b   (B)   False

21

A8
A2

(B)

19   If the acceleration of an object is zero, its
            velocity <u>must</u> be zero.

S17A
I.2.a   (A)   True
S17C
I.3.b   (B)   False

21

A8
A2

(B)

MOTION IN A PLANE

AND VECTORS

1   Which one of the following is <u>not</u> a scalar quantity?

S17A   (A)   density
I.2.b
S17C   (B)   distance
III.1.d
              (C)   force
S 22
              (D)   length
A2
              (E)   mass
(C)

***
-
***

2   How is a vector different from a scalar?

S17A   (A)   A vector has mass and a scalar does not.
I.2.a
S17C   (B)   A vector has a direction and a scalar does not.
I.4.a
              (C)   A vector measures speed while a scalar measures
S 22   velocity.

A2   (D)   A vector has a numeral and a unit while a scalar
                    does not.
(B)
              (E)   A vector measures distance while a scalar
**   measures displacement.
-
***

3

S17A
I.2.a
S17C
I.4.a

S 22

A2

(D)

**

--

***

Which of the following statements includes an example of a vector quantity?

(A) The density of aluminum is 2700 kg/m^3.

(B) Juanita walks 2 km to get water.

(C) The jogger runs 3 km around the track.

(D) Grimsby lies 24 km east of Hamilton.

(E) The speed limit on the Queen Elizabeth Way is 100 km/h.

4

S17A
I.2.a
S17C
I.4.a

S 22

A2

(A)

**

--

***

A scalar quantity is one which does <u>not</u> have a

(A) direction

(B) displacement

(C) magnitude

(D) numeral

(E) unit

5

S17A
I.2.a
S17C
I.4.a

S 22

A2

(A)

***

--

***

Which of the following quantities is <u>not</u> a scalar?

(A) acceleration

(B) energy

(C) mass

(D) temperature

(E) wind speed

6

Acceleration is <u>always</u> in the direction

S17A
I.2.a
S17C
I.3.c

(A)   of the displacement

(B)   of the initial velocity

(C)   of the final velocity

S 22

(D)   of the net force

A4
A2

(E)   opposite to the frictional force

(D)

***
—
***

7

An athlete completes two laps of a circular track
of radius 50.0 m. The total displacement of the
athlete at the end of the run is

S17A
I.2.a
S17C
I.4.a

(A)   0

(B)   50.0 m

S 22

(C)   100 m

A8
A2

(D)   314 m

(A)

(E)   728 m

**
—
***

8

A person walks 15 km [E], 5 km [S], 3 km [W], and
5 km [N]. The resultant displacement is

S17A
I.2.a
S17C

(A)   12 km

I.4.a

(B)   12 km [E]

23

(C)   15 km [E]

F1
A2

(D)   18 km [E]

(E)   28 km

(B)

**
—
***

9

S17A
I.2.a
S17C
I.4.a

23

F1
A2

(B)

*
—
**

A man walks 4.0 km north and then 3.0 km south. His position relative to the starting point is then

(A)   1.0 km

(B)   1.0 km north

(C)   1.0 km south

(D)   7.0 km

(E)   7.0 km north

10

S17A
I.2.a
S17C
I.4.a

S 23

F1

(A)

**
—
***

An object travels in a circle of radius r. After one complete revolution its displacement from the beginning point is

(A)   0

(B) $2r$

(C) 2π

(D) $2\pi r$

(E) $\dfrac{2\pi r}{t}$

11

S17A
I.2.a
S17C
I.4.b

24

F1
A8

(C)

***
—
***

A stream is flowing at a speed of 3.0 km/h relative to the bank. A boy who can swim at 2.0 km/h in still water enters the stream and proceeds to swim downstream. At a certain point he is approaching a boat going upstream. The boat has a speed of 20 km/h relative to the stream.

To an observer on the shore, the boat and the boy are approaching each other at a speed of

(A)   28 km/h

(B)   25 km/h

(C)   22 km/h

(D)   18 km/h

(E)   15 km/h

12

S17A
I.2.a
S17C
I.4.b

24

F1
A8

(C)

**
-
***

A hiker walks 3.0 m [E] and then 4.0 m [S]. The
magnitude of the displacement of the hiker is

(A)   7.0 m

(B) $\sqrt{7.0}$ m

(C)   5.0 m

(D)   1.0 m [SE]

(E)   1.0 m

13

S17A
I.2.a
S17C
I.4.b

24

F1
A8

(E)

**
-
***

A passenger on a bus walks towards the back of the
bus at 3.0 km/h relative to the bus, while the bus
travels south at 15 km/h. The passenger's velocity
relative to the road is

(A)   18 km/h north

(B)   18 km/h south

(C)   15 km/h south

(D)   12 km/h north

(E)   12 km/h south

14

S17A
I.2.a
S17C
I.4.b

S 24

A2

(E)

***
-
***

Which one of the following is a vector quantity?

(A)   density

(B)   distance

(C)   mass

(D)   time

(E)   velocity

15

Which of the following physical quantities is a vector quantity?

S17A
I.2.a
S17C
I.4.b

(A) length

(B) force

S 24

(C) time

A2

(D) mass

(B)

(E) speed

**
-
***

16

Particle X moves with a velocity of 15 m/s to the right. Particle Y moves with a velocity of 5.0 m/s to the left. What is the velocity of particle Y with reference to particle X?

S17A
I.2.a
S17C
I.4.b

(A) 5.0 m/s to the left

S 24

(B) 10 m/s to the right

F1
A4
A8

(C) 10 m/s to the left

(D) 20 m/s to the right

(E)

(E) 20 m/s to the left

***
-
***

17

Car A is travelling north at 50 km/h while directly behind it car B is travelling south at 30 km/h. The velocity of B relative to A is

S17A
I.2.e
S17C
I.4.b

(A) 80 km/h north

(B) 80 km/h south

S 25

(C) 20 km/h north

F1

(D) 20 km/h south

(B)

(E) 30 km/h south

***
-
***

18   Which one of the following is <u>not</u> a vector quantity?

S17A   (A)   acceleration
I.2.e
S17C   (B)   displacement
III.2.a
              (C)   force
S 26
              (D)   speed
A2
              (E)   weight
(D)

***
-
***

19   Which one of the following is <u>not</u> a vector quantity?

S17A   (A)   acceleration
I.3.b
S17C   (B)   displacement
III.5.a
              (C)   energy
S 26
              (D)   force
A2
              (E)   velocity
(C)

**
-
***

20   Which one of the following is <u>not</u> a vector quantity?

S17A   (A)   acceleration
I.2.e
S17C   (B)   force
III.2.a
              (C)   mass
S 26
              (D)   velocity
A2
              (E)   weight
(C)

***
-
***

21

S17A
I.3.b
S17C
III.5.a

S 26

A2

(B)

Which one of the following groups of terms does <u>not</u> contain a scalar quantity?

(A)   velocity, force, power

(B)   displacement, acceleration, force

(C)   acceleration, speed, work

(D)   energy, work, distance

(E)   pressure, weight, time

***
-
***

22

S17A
I.2.a
S17C
I.4.b

S 27

F1
A2

(A)

A car travels 4.0 km [E] and then 3.0 km [S]. The total trip requires 15 min. The average speed of the car for this trip is

(A)   28 km/h

(B)   20 km/h

(C)   11 km/h

(D)   4.0 km/h

(E)   0.47 km/h

**
-
***

23

S17A
I.2.a
S17C
I.4.d

S 29

A2
A1

(B)

An object is thrown vertically upward from the earth. While it is rising

(A)   its velocity and acceleration are both upward

(B)   its velocity is upward but its acceleration is downward

(C)   its velocity and acceleration are both downward

(D)   its velocity is downward but its acceleration is upward

(E)   its velocity and acceleration are both decreasing significantly

***
-
***

1   The sum of the displacements 3 m east and 4 m north
                is a displacement 7 m northeast.

S17A
I.2.a   (A)   True
S17C
I.4.b   (B)   False

24

A3
A7

(B)

*
—
***

DYNAMICS

FORCE AND

NEWTON'S LAWS

1

S17A
I.2.c
S17C
III.1.d

31
28

A3

(C)

A man pushes with a force $\vec{F}$ on the handle of a lawn-mower as shown. The angle between the handle and the horizontal is 45°.

***
-
***
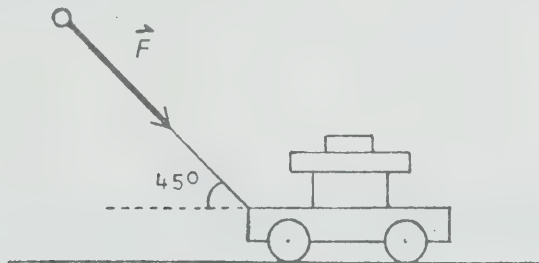
When this force is resolved into horizontal and vertical components,

(A) the horizontal component is greater than the vertical

(B) the vertical component is greater than the horizontal

(C) each component is less than $\vec{F}$

(D) each component is greater than $\vec{F}$

(E) each component is the same as $\vec{F}$

2

S17A
I.2.b
S17C
III.1.d

31

A4
A8

(C)

**

-

***

A force of 1.0 N is equivalent to

(A) 1.0 kg/s

(B) 1.0 kg·m/s

(C) 1.0 kg·m/s^2

(D) 1.0 kg·m^2/s

(E) 1.0 kg·m^2/s^2

3

S17A
I.2.c
S17C
III.1.d

31

F1

(E)

***
-
***

Three books, X, Y and Z, rest on a table as shown in the diagram. The weight of each book is indicated. The net or unbalanced force acting on book Y is

(A)   4 N down

(B)   5 N down

(C)   5 N up

(D)   10 N up

(E)   zero

4 N	X
5 N	Y
10 N	Z

4

S17A
I.2.c
S17C
III.1.d

31

F1
A7

(A)

***
-
***
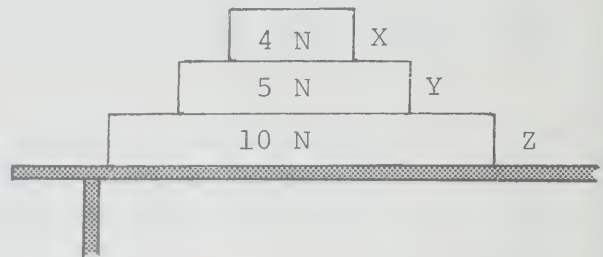
The resultant of two forces acting on a point is greatest when the angle between them is

(A)   0°

(B)   45°

(C)   90°

(D)   120°

(E)   180°

5

S17A
I.2.c
S17C
III.1.d

31

F1
A7

(E)

***
-
***

An elevator weighing 12 000 N is accelerating upward. The tension in the cable is 20 000 N and the frictional resistance to motion is 5 000 N. The unbalanced force on the elevator is

(A)   37 000 N up

(B)   27 000 N up

(C)   13 000 N up

(D)   8 000 N up

(E)   3 000 N up

6

S17A
I.2.c
S17C
III.1.d

31

F1
A7

(C)

*
–
**

The tension (T) in the rope attached
to the object shown is 5 N, and the
force of gravity (F) acting on the
object is 3 N. The unbalanced force
acting on the object is
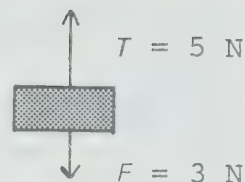
T = 5 N

F = 3 N

(A)   -2 N up

(B)   2 N down

(C)   2 N up

(D)   8 N down

(E)   8 N up

7

S17A
I.2.b
S17C
III.1.b

S 31

A1
A2

(A)

**
–
*

Which of the following factors will increase the
force of friction on a brick sliding on a
horizontal surface?

(A)   increasing the mass of the brick

(B)   decreasing the surface area in contact

(C)   increasing the surface area in contact

(D)   lubricating the surfaces in contact

(E)   decreasing the mass of the brick

8

S17A
I.2.a
S17C
III.1.d

S 31

A4
A2

(E)

*
–
***

Which of the following quantities is a vector?

(A)   1.5 Mm

(B)   26 μs

(C)   47 m/s

(D)   60 kg

(E)   85 N [W]

9   An object moving at constant velocity must

S17A   (A)   have a net force acting on it
I.2.b
S17C   (B)   eventually stop due to the force of gravity
III.1.a
            (C)   not have a force of gravity acting on it
32
            (D)   have all forces acting on it balance each other
A8
            (E)   not have a force of friction acting on it
(D)

**
–
***

10   An object moves along a level road with constant
            velocity. The net force acting on the object is
S17A
I.2.c   (A)   in the direction of motion
S17C
III.1.a   (B)   opposite to the direction of motion

32   (C)   upward

A8   (D)   downward

(E)   (E)   zero

***
–
***

11   The inertia of an object is most closely related to
            its
S17A
I.2.b   (A)   density
S17C
III.1.a   (B)   mass

32   (C)   position

A8   (D)   shape

(B)   (E)   volume

**
–
***

12

S17A
I.2.b
S17C
III.1.a

32

A8

(E)

***
-
***

The tension (T) in a string attached to an object is equal to the force of gravity (F) acting on the object. Consider the following statements concerning the motion of the object.
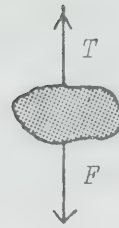
I.   It is moving upward at constant speed.

II. It is moving downward at constant speed.

III. It is stationary.

Which of the above motions is/are possible?

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I, II and III

13

S17A
I.2.c
S17C
III.1.d

32
33

A8

(C)

***
-
***

Which of the following statements is <u>always</u> true?

(A) If an object is at rest, no forces act on it.

(B) If an object is moving, an unbalanced force acts on it.

(C) If an object is moving, it has a natural tendency to keep moving.

(D) If an object is moving, it has a natural tendency to come to rest.

(E) If an object is moving in a circle, no forces act on it.

14   An object in free fall has reached its terminal
             velocity when it has

S17A
I.2.b   (A)   reached the acceleration due to gravity
S17C
III.1.a   (B)   a constant increase in velocity

S 32   (C)   a constant decrease in velocity

F1   (D)   a constant velocity
A8
             (E)   no forces acting on it
(D)

***
-
***

15   A small toy balloon filled with helium has a 10 cm
             ribbon hanging straight down from the bottom when
S17A   it is at rest. The balloon and ribbon are released
I.2.b   and carried horizontally at constant velocity by a
S17C   uniform 30 km/h west wind. During this motion the
III.1.a   ribbon

S 32   (A)   trails west from the balloon

F1   (B)   trails east from the balloon
A8
             (C)   waves from side to side
(E)
             (D)   waves up and down
***
-            (E)   does none of the above
***

16   The acceleration of a moving object is <u>always</u> in
             the direction
S17A
I.2.c   (A)   of the initial velocity
S17C
III.1.d   (B)   of the final velocity

33   (C)   of the net force

A8   (D)   of the frictional force

(C)   (E)   opposite to the frictional force

***
-
***

17   If a small unbalanced force acts on an object, the
              object

S17A
I.2.c   (A)   remains stationary
S17C
III.1.d   (B)   moves at a constant velocity

33   (C)   accelerates

A8   (D)   comes to rest and remains at rest

(C)   (E)   moves with uniform motion

**
–
***

18   This question involves two statements:

S17A   I.   A hockey puck sliding on ice
I.2.c   eventually comes to rest.
S17C
III.1.d   II. There is a force of friction between
                           the ice and a sliding hockey puck.
33
              Which of the following responses correctly describes
A10   the two statements?

(A)   (A)   Both statements are true and one statement can
                    be used to explain the other.
*
–   (B)   Both statements are true, but neither statement
**   can be used to explain the other.

              (C)   Statement I is true.
                    Statement II is false.

              (D)   Statement I is false.
                    Statement II is true.

              (E)   Statement I is false.
                    Statement II is false.

19

S17A
I.2.c
S17C
III.1.d

33

D3
F1
A8

(A)

***
—
***

An object travels in a
straight line toward a
Point P. The table
shows positions of the
object at specific
times.

Position (m [E] of P)	Time (s)
40	0
32	1
22	2
10	3

The net force acting
on the object is

(A)   constant and acts in the direction of motion

(B)   increasing and acts in the direction of motion

(C)   constant and acts in the direction opposite to
      that of the motion

(D)   increasing and acts in the direction opposite
      to that of the motion

(E)   decreasing and acts in the direction opposite
      to that of the motion

20

S17A
I.2.c
S17C
III.1.d

S 33

F1
A8

(D)

***
—
***

An elevator is moving upward. Which one of the
following statements about the forces on the
elevator is true?

(A)   There must be an unbalanced force upward.

(B)   There must be an unbalanced force downward.

(C)   The forces upward and downward must be equal.

(D)   The forces upward and downward may be equal
      or unequal.

(E)   The forces upward and downward must be unequal.

21

S17A
I.2.c
S17C
III.1.d

34

E5
F1

(D)

***

–

***

According to Newton's second law, the acceleration of an object is directly proportional to the net force applied to it. A student does an experiment to investigate this law. He applies a constant force F to a wooden block which is free to slide on a table, and measures the resulting acceleration a. He then applies twice the force and finds that the acceleration has tripled.

Which one of the following statements is the correct conclusion to draw from this result?

(A) Newton's second law is not valid under these conditions.

(B) There is a frictional force of $\frac{1}{4}F$ on the block.

(C) There is a frictional force of $\frac{1}{3}F$ on the block.

(D) There is a frictional force of $\frac{1}{2}F$ on the block.

(E) There is a frictional force of $\frac{2}{3}F$ on the block.

22

S17A
I.2.c
S17C
III.1.d

S 34

A10
A8

(C)

***

–

***

A force F is applied opposite to the direction of motion to an object sliding along a horizontal surface. A force of friction F_f, which is smaller than F, is also present.

Which of the following statements is true?

(A) The object is moving at constant velocity.

(B) The applied force and the force of friction act in opposite directions.

(C) The object is slowing down.

(D) The object is speeding up.

(E) The object will come to rest and stay at rest.

23   In base units, one newton is

S17A   (A)   0.10 kg
I.2.c
S17C   (B)   10 kg
III.1.d
              (C)   1 kg·m/s
35
              (D)   1 kg·m^2/s
A2
              (E)   1 kg·m/s^2
(E)

**
−
***

24   The definition of a newton is

·S17A   (A)   the force of gravity on a 1 kg mass
I.2.c
S17C   (B)   the force of gravity on a 10 kg mass
III.1.d
              (C)   the force that gives a 1 kg mass an acceleration
35   of 1 cm/s^2

A2   (D)   the force that gives a 1 kg mass an acceleration
                      of 1 m/s^2
(D)
              (E)   the force that gives a 1 kg mass an acceleration
***   of 10 m/s^2
−
***

25   One newton is equivalent to

S17A   (A)   1 kg·m
I.2.c
S17C   (B)   1 kg·m/s
III.1.d
              (C)   1 kg·m/s^2
35
              (D)   1 kg·m^2/s^2
A2
              (E)   1 m/(kg·s^2)
(C)

**
−
***

26   A block of iron which has a mass of 5.0 kg has a
              weight on earth closest to

S17A

I.2.e   (A)   0.50 N

S17C

III.2.a   (B)   5.0 kg

35   (C)   5.0 N

A8   (D)   50 N

(D)   (E)   5.0 x 10^3 N

**
—
***

27   An object is given an acceleration of 5.0 m/s^2 by a
              net force of 10 N.   The mass of the object is

S17A

I.2.c   (A)   0.50 kg

S17C

III.1.d   (B)   2.0 kg

35   (C)   15 kg

A8   (D)   20 kg

(B)   (E)   50 kg

**
—
***

28   A dynamics cart of mass 0.20 kg, initially at rest,
              is acted upon by an unbalanced force of 3.0 N.

S17A

I.2.c   The acceleration of the cart is

S17C

III.1.d   (A)   0.070 m/s^2

35   (B)   1.5 m/s^2

A8   (C)   7.5 m/s^2

(D)   (D)   15 m/s^2

**   (E)   30 m/s^2
—
***

29

S17A
I.2.c
S17C
III.1.d

35

A8

(D)

***
-
***

When a number of forces are applied to an object, the acceleration produced is

(A)   equal to the numerical sum of the forces acting on the object

(B)   equal to the unbalanced force acting on the object

(C)   directly proportional to the mass of the object

(D)   directly proportional to the unbalanced force acting on the object

(E)   directly proportional to the product of the mass and the unbalanced force on the object

30

S17A
I.2.c
S17C
III.1.d

35

A8

(A)

**
-
***

A net force of 2.0 N acting on a 5.0 kg mass will produce an acceleration of magnitude

(A) $0.40 \ m/s^2$

(B) $2.5 \ m/s^2$

(C) $3.0 \ m/s^2$

(D) $5.0 \ m/s^2$

(E) $10 \ m/s^2$

31

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

***
-
***

A net force of 25 N north acts on an object of mass 75 kg. The acceleration of the object is

(A) $0.30 \ m/s^2$ south

(B) $0.33 \ m/s^2$ north

(C) $3.0 \ m/s^2$ north

(D) $50 \ m/s^2$ north

(E) $1.0 \times 10^2 \ m/s^2$ north

32

S17A
I.2.a
S17C
III.2.a

35

A8
A10

(E)

***
-
***

Two objects, one having three times the mass of the
other, are dropped from the same height in a vacuum.
Their velocities, on reaching the end of their fall,
are equal because

(A)   the velocity of anything falling in a vacuum is
      constant

(B)   all objects reach the same terminal velocity
      when dropped from great heights

(C)   the acceleration due to gravity of the larger
      object is three times the acceleration due to
      gravity of the smaller object

(D)   the force of gravity acting on both objects is
      the same

(E)   the acceleration due to gravity for both objects
      is the same

33

S17A
I.2.d
S17C
III.4.b

35

F1
A8

(D)

***
-
***

A constant force of 36 N is applied to mass X, as
shown.   Mass X is in contact with mass Y on a
frictionless surface.
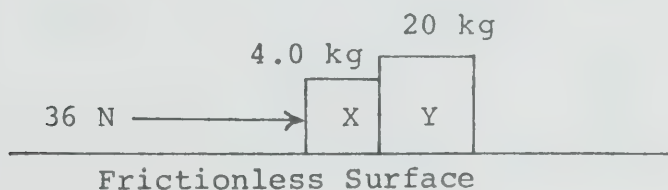
What is the magnitude of the force exerted by mass X
on mass Y?

(A)   1.5 N

(B)   6.0 N

(C)   29 N

(D)   30 N

(E)   36 N

34

S17A
I.2.c
S17C
III.1.d

35

F1

(D)

***
-
***

A man is pushing a 500 kg refrigerator across a
level floor. He exerts a constant force of 200 N
to maintain a velocity of 0.10 m/s. When the man
stops pushing, the refrigerator will come to a
stop in

(A)   0 s

(B)   0.010 s

(C)   0.040 s

(D)   0.25 s

(E)   4.0 s

35

S17A
I.2.c
S17C
III.1.d

35

F1

(D)

***
-
***

A body of mass 5.0 kg is moving on a **smooth surface**
with a velocity of 6.0 m/s to the right. A constant
force is applied for 3.0 s, giving the body a final
velocity of 12 m/s to the left.

The applied force was

(A)   10 N to the left

(B)   10 N to the right

(C)   20 N to the left

(D)   30 N to the left

(E)   30 N to the right

36

S17A
I.2.c
S17C
III.1.d

35

F1

(B)

***
-
***

A 10 kg mass is lifted so that it rises with an
acceleration of 2.0 m/s^2. (g = 10 N/kg)

The net force exerted upwards is

(A)   10 N

(B)   20 N

(C)   1.0 x 10^2 N

(D)   1.2 x 10^2 N

(E)   2.0 x 10^2 N

37   A net force of 15 N acting on a mass of 5.0 kg
                 produces an acceleration of

S17A
I.2.c   (A)   0.33 m/s^2
S17C
III.1.d   (B)   1.5 m/s^2

35   (C)   3.0 m/s^2

F1   (D)   15 m/s^2

(C)   (E)   75 m/s^2

**
-
**

38   An object of mass 15 kg accelerates at 5.0 m/s^2.
                 The unbalanced force being applied is

S17A
I.2.c   (A)   3.0 N
S17C
III.1.d   (B)   10 N

35   (C)   45 N

F1   (D)   75 N
A8
                 (E)   1.5 x 10^2 N
(D)

**
-
***

39   A 10.0 kg box is accelerated from rest to 4.00 m/s
                 in 1.00 s. The force of kinetic friction on the box
S17A   is 5.00 N. What is the size of the applied force?
I.2.c
S17C   (A)   9.00 N
III.1.d
                 (B)   35.0 N
35
                 (C)   40.0 N
F1
A8   (D)   45.0 N

(D)   (E)   145 N

***
-
***

40

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(A)

***
–
***

If the mass of an object is 15.0 kg, what net force
will cause it to accelerate from rest to a velocity
of 10.0 m/s west in a time of 5.00 s?

(A)   30.0 N west

(B)   37.5 N west

(C)   60.0 N west

(D)   150 N west

(E)   750 N west

41

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(D)

**
–
***

What is the mass of a body that is given an acceler-
ation of 5.0 m/s^2 by a net force of 10 N?

(A)   50 kg

(B)   25 kg

(C)   2.0 g

(D)   2.0 kg

(E)   0.50 kg

42

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(A)

***
–
***

A 70.0 kg parachutist, falling toward the earth,
experiences an upward force of 550 N due to air
resistance.   (g = 10.0 N/kg)

The unbalanced force on the parachutist is

(A)   150 N down

(B)   150 N up

(C)   480 N up

(D)   550 N up

(E)   620 N down

43

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

***
−
***

A force of 300 N is applied to a box on a rough floor.
The frictional force is 100 N. The acceleration of
the box is 5.0 m/s^2. The mass of the box is

(A)   20 kg

(B)   40 kg

(C)   60 kg

(D)   80 kg

(E) 1.0×10^3 kg

44

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

**
−
***

A force of 12 N is applied to a 6.0 kg mass. If
there is no retarding force such as friction, the
acceleration is

(A)   0.50 m/s^2

(B)   2.0 m/s^2

(C)   6.0 m/s^2

(D)   20 m/s^2

(E)   72 m/s^2

45

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

***
−
***

A horizontal force of 10 N, applied to a 2.0 kg box
sitting on the floor, gives the box an acceleration
of 3.0 m/s^2. The force of friction on the box must
be

(A)   0

(B)   4.0 N

(C)   6.0 N

(D)   8.0 N

(E)   10 N

46

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(A)

**

—

***

A carpenter applies a 40 N force to accelerate a hammer head at 50 m/s^2. The mass of the hammer head is

(A)   0.80 kg

(B)   1.3 kg

(C)   10 kg

(D)   9.0 x 10^1 kg

(E)   2.0 x 10^3 kg

47

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

*

—

**

If a 34 kg canoe is pushed forward by an unbalanced force of 323 N, its acceleration will be

(A)   0.11 m/s^2

(B)   9.5 m/s^2

(C)   10 m/s^2

(D)   3.5 x 10^2 m/s^2

(E)   1.1 x 10^4 m/s^2

48

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(D)

**

—

***

A steel ball of mass 1.0 kg rolls down an inclined track where the friction is 2.0 N. The pull of gravity on the ball supplies a force of 5.0 N along the track.

The acceleration of the ball along the track is

(A)   7.0 m/s^2 down

(B)   5.0 m/s^2 down

(C)   3.0 m/s^2 up

(D)   3.0 m/s^2 down

(E)   2.0 m/s^2 up

49

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(A)

**
-
***

A net force of 15 N is acting on an object of mass 45 kg. The acceleration of the object is

(A) 0.33 m/s^2

(B) 3.0 m/s^2

(C) 30 m/s^2

(D) 60 m/s^2

(E) $6.8 \times 10^2 \text{ m/s}^2$

50

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(B)

**
-
***

A net force of 12 N acting on a mass of 6.0 kg will produce an acceleration of

(A) 0.50 m/s^2

(B) 2.0 m/s^2

(C) 6.0 m/s^2

(D) 18 m/s^2

(E) 72 m/s^2

51

S17A
I.2.c
S17C
III.1.d

35

F1
A8

(A)

**
-
***

A net force of 2.0 N acting on a 5.0 kg mass will produce an acceleration of

(A) 0.40 m/s^2

(B) 2.0 m/s^2

(C) 2.5 m/s^2

(D) 10 m/s^2

(E) 20 m/s^2

52

S17A
I.2.c
S17C
III.1.d

35
19

F1
A8

(B)

**
-
***

A car having a mass of 1 500 kg and travelling at 5.0 m/s is accelerated for 10 s to a speed of 24 m/s.   The net force is

(A) 7.5×10^2 N

(B) 2.9×10^3 N

(C) 3.6×10^3 N

(D) 4.4×10^3 N

(E) 3.6×10^4 N

53

S17A
I.2.c
S17C
III.1.d

35
19

F1
A8

(C)

**
-
***

A car has a mass of 1500 kg.   What unbalanced force is needed to accelerate the car from 5.00 m/s to 25.0 m/s in 10.0 s?

(A) 5.00×10^2 N

(B) 7.50×10^2 N

(C) 3.00×10^3 N

(D) 3.75×10^3 N

(E) 4.50×10^3 N

54

S17A
I.2.c
S17C
III.1.d

35
42

F1

(D)

***
-
***

A 4 kg body was accelerated from 10 m/s to 18 m/s by an unbalanced force of 8 N.   The unbalanced force was applied for

(A)   0.5 s

(B)   1 s

(C)   2 s

(D)   4 s

(E)   8 s

55

S17A
I.2.e
S17C
III.2.a

S 35

A1

(B)

**

—

***

A 10 kg box of feathers and a 1.0 kg lead ball are dropped from rest in a vacuum on the moon. The acceleration of the box of feathers is

(A)   ten times as large as that of the lead ball

(B)   the same as that of the lead ball

(C)   one-tenth as large as that of the lead ball

(D)   10 m/s^2

(E)   zero since it floats in a vacuum

56

S17A
I.2.e
S17C
III.2.a

S 35

A1
A2

(D)

**

—

***

The acceleration of a falling mass in a vacuum near the surface of the earth

(A)   is larger for a larger mass

(B)   increases quickly as the mass falls

(C)   is smaller for a larger mass

(D)   is the same for all masses

(E)   decreases to zero as the mass falls

57

S17A
I.2.c
S17C
III.1.d

S 35
S 17

A6
A2

(B)

***

—

***

Select the scalar quantity from the following list.

(A)   velocity

(B)   speed

(C)   force

(D)   displacement

(E)   acceleration

58

S17A
I.2
S17C
I.4.b

S 35

A2

(B)

***
-
***

Multiplying physical quantities together can yield
a new physical quantity. Consider the following
products:

      I.   acceleration times time

     II.   mass times velocity

    III. mass times acceleration

    IV.   mass times force

     V.   mass times time

Assuming that all the products are new physical
quantities, which of the above new physical
quantities is/are scalar?

(A)   II only

(B)   V only

(C)   I and III only

(D)   I and IV only

(E)   II, III and IV only

59

S17A
I.2.e
S17C
III.2.a

S 35

A2
A5

(C)

*
-
**

The gravitational force fields
of several planets are listed
in the table.

If you stand on the same
spring scale on all of the
planets, on which one will
your weight be the largest?

(A)   Earth

(B)   Mercury

(C)   Saturn

(D)   Uranus

(E)   Venus

Planet	g (N/kg)
Earth	10
Mercury	3.6
Saturn	12
Uranus	11
Venus	8.6

60   Select the scalar quantity from the following list.

S17A   (A)   acceleration
I.2.c
S17C   (B)   displacement
III.1.d
              (C)   force
S 35
S 17   (D)   mass

A6   (E)   velocity
A2

(D)

***
-
***

61   Select the scalar quantity from the following list:

S17A   (A)   acceleration
I.2.c
S17C   (B)   displacement
III.1.d
              (C)   force
S 35
S 17   (D)   time

A6   (E)   velocity
A2

(D)

***
-
***

62

S17A
I.2.c
S17C
III.1.d

S 35

A8
A10

(D)

**

-

***

The downward force of gravity on an elevator is 10^4 N. The upward force acting on the elevator is 10^4 N. Which of the following statements is <u>not</u> correct?

(A) The elevator could be at rest.

(B) The elevator could be moving upward with constant speed.

(C) The elevator could be moving downward with constant speed.

(D) The elevator could be accelerating upward.

(E) The net force on the elevator is zero.

63

S17A
I.2.e
S17C
III.2.a

S 35

F1
A2

(E)

**

-

***

An object of mass 5.0 kg at the surface of the earth will have a weight close to

(A) 0.50 N

(B) 2.0 N

(C) 5.0 N

(D) 45 N

(E) 50 N

64

S17A
I.2.c
S17C
III.1.d

S 35

F1
A8

(B)

***

-

***

A 2.0 kg box is pulled along the floor by a force of 10 N and experiences an acceleration of 3.0 m/s^2. The force of friction is

(A) 0

(B) 4.0 N

(C) 5.0 N

(D) 6.0 N

(E) 8.5 N

65

S17A
I.2.e
S17C
III.2.a

S 35

F1
A7

(A)

***
−
***

A paratrooper predicts that objects have less weight
at high altitudes. He tests this prediction by
using a spring scale calibrated in newtons to weigh
a kilogram of butter while falling from an altitude
of 5000 m. (g = 10 m/s^2)

What will the spring scale read during the first
second of fall and before the parachute opens?

(A)   0

(B)   0.10 N

(C)   slightly less than 10 N

(D)   10 N

(E)   slightly more than 10 N

66

S17A
I.2.e
S17C
III.2.a

S 35

F1
A7

(C)

***
−
***

A paratrooper predicts that objects have less weight
at high altitudes. He tests this prediction by
using a spring scale calibrated in newtons to weigh
a kilogram of butter while falling from an altitude
of 5000 m. (g = 10 m/s^2)

What will the spring scale read when the parachute
opens and he falls at terminal velocity near the
ground?

(A)   0

(B)   about 8 N

(C)   10 N

(D)   more than 10 N

(E)   the reading cannot be predicted

67

S17A
I.2.e
S17C
III.2.a

S 35

F1
A8

(C)

**
-
***

In the year 2020 an astronaut makes a routine visit to the moon where g is 1.6 N/kg. The astronaut has a mass of 50 kg on earth where g is 10 N/kg.

What force of gravity acts on the astronaut on the moon's surface?

(A) 31 N

(B) 31 kg

(C) 80 N

(D) 80 kg

(E) 5.0×10^2 N

68

S17A
I.2.e
S17C
III.2.a

S 35

F1
A8
A2

(A)

***
-
***

An astronaut leaves Earth, where g is 10.0 N/kg, and lands on Jupiter, where g is 26.4 N/kg. The astronaut has a mass of 50.0 kg on Earth. What is the mass of the astronaut on Jupiter?

(A) 50.0 kg

(B) 76.4 kg

(C) 500 N

(D) 1.32×10^3 kg

(E) 1.32×10^3 N

69

S17A
I.2.e
S17C
III.2.a

36

A2

(B)

***
-
***

The mass of an object

(A) depends on its location

(B) is a measure of its ability to resist changes in motion

(C) is numerically equal to its weight

(D) is measured by a spring balance

(E) has the same units as weight

70   The inertia of a body depends on the

S17A   (A)   position of the body
I.2.b
S17C   (B)   mass of the body
III.1.a
              (C)   motion of the body
36
              (D)   net force on the body
A2
              (E)   volume of the body
(B)

***
-
***

71   The acceleration due to gravity is

S17A   (A)   measured using an equal arm balance
I.2.e
S17C   (B)   constant at a specific location
III.2.a
              (C)   equal to the force of gravity
S 36
              (D)   independent of position
A1
A3   (E)   dependent on the mass of the object
A8

(B)

***

***

72   Which of the following is <u>not</u> affected by the force
              of gravity?
S17A
I.2.e   (A)   the weight of an object
S17C
III.2.a   (B)   the work to lift an object

S 36   (C)   the energy to lift an object

A2   (D)   the air pressure on an object
A1
              (E)   the mass of an object
(E)

***
-
***

73

S17A
I.2.c
S17C
III.1.c

S 36

F1
A7

(D)

**

-

***

An experimenter uses a bathroom scale to measure his weight while riding in an elevator. How will the reading on the bathroom scale compare to the normal reading for the following sequence of the elevator's motion: elevator starts to descend; elevator descends at a constant velocity; elevator stops?

(A) lighter, lighter, heavier

(B) lighter, heavier, heavier

(C) heavier, normal, heavier

(D) lighter, normal, heavier

(E) lighter, normal, lighter

74

S17A
I.2.d
S17C
III.4.b

37

A8

(E)

***

-

***

A lead mass is suspended by a string held by your hand. The reaction to the force of gravity on the lead is the force exerted by

(A) the string on the lead

(B) the lead on the string

(C) the hand on the string

(D) the string on the hand

(E) the lead on the earth

75

S17A
I.2.d
S17C
III.4.b

37

A8

(D)

Whenever one body exerts a force on a second body the second body exerts a force on the first body which is

(A) slightly smaller in magnitude and in the same direction

(B) slightly smaller in magnitude and in the opposite direction

(C) equal in magnitude and in the same direction

(D) equal in magnitude and in the opposite direction

(E) slightly larger in magnitude and in the opposite direction

76

S17A
I.2.d
S17C
III.4.b

37

A8
A10

(D)

***
-
***

"A book is lying on the table. The table is exert-
ing an upward force on the book which is equal to the
downward force exerted by the book on the table."
This example illustrates

(A)   Galileo's Law of Inertia

(B)   Newton's First Law

(C)   Newton's Second Law

(D)   Newton's Third Law

(E)   Newton's Law of Universal Gravitation

77

S17A
I.2.d
S17C
III.4.b

37

F1
A8

(E)

**
-
***

What force would balance the weight of an object
with a mass of 6.0 kg?   (g = 10 N/kg)

(A)   0.60 N up

(B)   6.0 N down

(C)   6.0 N up

(D)   60 N down

(E)   60 N up

78

S17A
I.2.d
S17C
III.4.b

37

F1
A8

(D)

***
-
***

What force would balance the force of gravity on an
800 g object?   (g = 10.0 m/s^2)

(A) 8.00×10^3 N up

(B)   800 N up

(C)   80.0 N up

(D)   8.00 N up

(E)   0.800 N up

79

S17A
I.2.d
S17C
III.4.b

S 37

A8
A2

(B)

***
-
***

Action and reaction forces always occur in pairs.
They do not cancel each other because

(A)   the action force is greater than the reaction
      force

(B)   the action and reaction forces act on different
      objects

(C)   the action and reaction forces act in the same
      direction

(D)   the reaction force acts only after the action
      force is removed

(E)   the reaction force is greater than the action
      force

80

S17A
I.2.d
S17C
III.4.b

S 37

F1
A8
A2

(A)

***
-
***

A 1.0 kg bird is flying in a 5.0 kg enclosed cage
made entirely of glass.   (g = 10 m/s^2)

The combination will weigh

(A)   60 N

(B)   50 N

(C)   6.0 kg

(D)   5.0 kg

(E)   4.0 kg

81

S17A
I.2.e
S17C
III.1.c

S 37

F1
A8
A2

(E)

***
-
***

A 1.0 kg bird is flying in a 5.0 kg cage made of
thin wire mesh. Air can circulate freely between
the inside and the outside of the cage. (Assume
g = 10 m/s^2.)

The combination will weigh

(A)   5.0 kg

(B)   6.0 kg

(C)   6.0 N

(D)   50 N

(E)   60 N

1   The acceleration due to gravity is greater on the
               moon than on the earth.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 31

A8

(B)

2   The acceleration due to gravity is constant at a
               specific location.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 31

A8

(A)

3   The acceleration due to gravity is equal to the
               force of gravity on an object.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 31

A8

(B)

4   The acceleration due to gravity is independent of
         position.
S17A
I.2.e   (A)   True
S17C
III.2.a (B)   False

S 31

A8

(B)

5   The acceleration due to gravity is dependent on the
         mass of an object.
S17A
I.2.e   (A)   True
S17C
III.2.a (B)   False

S 31

A8

(B)

6   When a car is parked on a hill, there is no unbalanced
         force acting on the car.
S17A
I.2.e   (A)   True
S17C
III.2.a (B)   False

32

A2
A3

(A)

***
-
***

7   If there is no net force acting on a body, the
             acceleration of the body <u>must be</u> zero.
S17A
I.2.c   (A)   True
S17C
III.1.d   (B)   False

32

A8

(A)

**
-
**

8   Newton's first law was experimentally verified by
             Newton.
S17A
I.2.b   (A)   True
S17C
III.1.a   (B)   False

32

I3
A1

(B)

***
-
***

9   A moving body which experiences an unbalanced force
             must move in the direction of the unbalanced force.
S17A
I.2.c   (A)   True
S17C
III.1.d   (B)   False

33

A5
A8

(B)

***
-
***

10   One newton is equivalent to 1 kg·m/s^2.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

35

A2
A11

(A)

*
-
*

11   Newton's second law ($\vec{F}_{net} = m\vec{a}$) holds true only if
                frictional forces are ignored.
S17A
I.2.c   (A)   True
S17C
III.1.d   (B)   False

35

A8
A2

(B)

***
-
**

12   Force is a unit of measurement.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

S 35

A1
A2

(B)

13   In SI, a unit of force is the newton per kilogram.

S17A   (A)   True
I.2.b
S17C   (B)   False
III.1.b

S 35

A2

(B)

14   A 500 kg block at rest on a horizontal frictionless
              surface would <u>not</u> accelerate with the application
S17A   of a horizontal 0.01 N force because this force is
I.2.c   <u>not</u> large enough to overcome the inertia of the body.
S17C
III.1.c   (A)   True

36   (B)   False

A3

(B)

**
—
***

15   Mass is a unit of measurement.

S17A   (A)   True
I.2.c
S17C   (B)   False
III.1.d

S 36

A1
A2

(B)

*
—
*

16   Weight and force have both magnitude and direction.

S17A   (A)   True
I.2.e
S17C   (B)   False
III.2.a

S 36

A1
A2

(A)

17   Weight and force have both magnitude and direction.

S17A   (A)   True
I.2.e
S17C   (B)   False
III.2.a

S 36

A1
A2

(A)

18   Weight is a vector quantity since it has magnitude
               and direction.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 36

A1
A2

(A)

19   Mass is a scalar quantity since it has magnitude
             only.

S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 36

A1
A2

(A)

20   The mass of a body depends on its surroundings and
             position.

S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 36

A1
A2

(B)

21   The acceleration due to gravity is measured using
             an equal arm balance.

S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 36

A1
A3
A8

(B)

22   In SI, the base unit of mass is the kilogram.

S17A   (A)   True
I.2.b
S17C   (B)   False
III.1.b

S 36

A2

(A)

23   In SI, the base unit of mass is the litre.

S17A   (A)   True
I.2.b
S17C   (B)   False
III.1.b

S 36

A2

(B)

24   In SI, the base unit of mass is the newton.

S17A   (A)   True
I.2.b
S17C   (B)   False
III.1.b

S 36

A2

(B)

25   In SI, a unit of mass is the newton per kilogram.

S17A   (A)   True
I.2.b
S17C   (B)   False
III.1.b

S 36

A2

(B)

26   The force of gravity acting on a baseball can be
              read directly using an equal arm balance.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 36

B4

(B)

**

–

***

27   A student holds a book in his hand. The earth exerts
              a downward gravitational force on the book. The
S17A   reaction to this force on the book is the force of
I.2.d   the hand upon the book.
S17C
III.3.b   (A)   True

37   (B)   False

A2
A8

(B)

***

–

***

CENTRIPETAL FORCE

AND GRAVITATION

1

S17A
I.2.e
S17C
III.3.b

40

A8

(B)

The force of attraction between any two objects in the universe is directly proportional to

(A)   the sum of their masses

(B)   the product of their masses

(C)   the square of the sum of their masses

(D)   the distance between their centres

(E)   the square of the distance between their centres

***
-
***

2

S17A
I.2.e
S17C
III.3.b

40

A8

(E)

Which one of the following is not an expression for force?

(A) ma

(B) W/d

(C) Gm_1m_2/d^2

(D) $m(v_f - v_i)/t$

(E) Wd

***
-
***

3

S17A
I.2.e
S17C
III.3.b

40

A8

(B)

***
—
***

The force of attraction between any two particles
in the universe is directly proportional to

(A)   the sum of their masses

(B)   the product of their masses

(C)   the distance between their centres

(D)   the square of the distance between their centres

(E)   one divided by the distance between their centres

4

S17A
I.2.e
S17C
III.3.b

40

F1
A8

(A)

***
—
***

An object is moved so that its distance from the
centre of the earth is doubled. The force of
gravity on the object

(A)   becomes four times smaller

(B)   becomes four times larger

(C)   becomes two times smaller

(D)   becomes two times larger

(E)   remains unchanged

5

S17A
I.2.e
S17C
III.3.b

40

F1
A8

(C)

**
—
**

Planet X has the same diameter as Earth, but three
times the mass of Earth. The ratio of the force of
gravity on the surface of Planet X to the force of
gravity on the surface of Earth would be

(A)   9:1

(B)   6:1

(C)   3:1

(D)   1:1

(E)   1:3

6   This question involves two statements:

S17A   I.   Astronauts experience "weightlessness"
I.2.e   in a satellite orbiting the earth.
S17C
III.3.b   II.   The gravitational force exerted by the
                       earth on astronauts is zero.
40
          Which of the following responses correctly describes
F1   the two statements?
A10
          (A) Both statements are true and one statement can
(C)   be used to explain the other.

***   (B) Both statements are true, but neither statement
-              can be used to explain the other.
***
          (C) Statement I is true.
               Statement II is false.

          (D) Statement I is false.
               Statement II is true.

          (E) Statement I is false.
               Statement II is false.

7   Which of the following statements is <u>not</u> correct?

S17A   (A) Weight and force have both magnitude and
I.2.e   direction.
S17C
III.2.a   (B) The weight of a body on earth is a measure
               of the gravitational attraction of the earth
S 40   on that body.
S 36
          (C) Weight is a vector quantity since it has
A1   magnitude and direction.
A2
          (D) Mass is a scalar quantity since it has
(E)   magnitude only.

***   (E) The mass of a body depends on its surroundings
-              and position.
***

8   This question involves two statements:

S17A   I.   The moon orbits about the earth.
I.2.e
S17C   II.   The earth exerts a gravitational
III.3.b   force on the moon.

S 40   Which of the following responses correctly describes
S 38   the two statements?

A8   (A) Both statements are true and one statement can
               be used to explain the other.
(A)
          (B) Both statements are true, but neither statement
**   can be used to explain the other.
—
**   (C) Statement I is true.
               Statement II is false.

          (D) Statement I is false.
               Statement II is true.

          (E) Statement I is false.
               Statement II is false.

9   The proportionality statement $F_g \propto m_1 m_2 / d^2$ shows
               the relationship between the gravitational force F_g,
S17A   the size of two masses m_1 and m_2, and the distance d
I.2.e   between their centres. If F_g doubles, this means
S17C   that
III.3.b
               (A) d has doubled
S 40
               (B) m_1 and m_2 have both doubled
F1
A8   (C) d has halved

(E)   (D) m_1 or m_2 has halved

***   (E) none of the above is correct
—
***

1   Newton's Law of Universal Gravitation explains why
              the gravitational force exists.
S17A
I.2.e   (A)   True
S17C
III.3.b   (B)   False

40

I2
A8

(B)

**
–
***

2   The weight of a body on earth is a measure of the
              gravitational attraction of the earth on that body.
S17A
I.2.e   (A)   True
S17C
III.2.a   (B)   False

S 40

A1
A2

(A)

IMPULSE AND

CONSERVATION OF

MOMENTUM

1

S17A
I.2.d
S17C
III.4.b

Imagine a light string passing over a frictionless pulley with a monkey hanging on one end of the string and an iron bar on the other end. The monkey and the bar have the same mass and both are initially at rest. When the monkey starts to climb up the string

42

F1
A8

(E)

***
−
***

(A) the bar will remain at rest and the monkey will rise

(B) the bar will rise and the monkey will fall

(C) the bar will rise and the monkey will remain at rest

(D) the bar will fall and the monkey will rise

(E) the bar and the monkey will rise together

2

S17A
I.2.d
S17C
III.4.b

S 42

A8

(C)

***
−
***

When you push against the wall of a building, the building pushes back with a force which is equal in magnitude but opposite in direction. This is an example of

(A) Newton's first law of motion

(B) Newton's second law of motion

(C) Newton's third law of motion

(D) Newton's law of universal gravitation

(E) Galileo's law of inertia
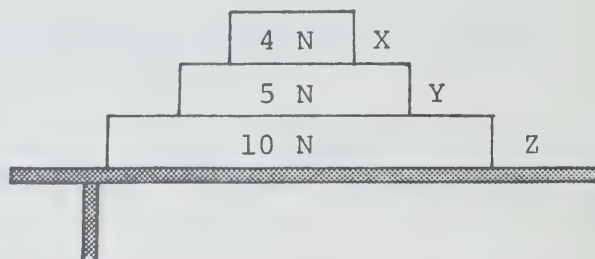
3

S17A
I.2.d
S17C
III.4.b

S 42

F1
A8

(B)

***
–
***

Three books, X, Y and Z, rest on a table as shown in the diagram. The weight of each book is indicated. The reaction to the force of gravity on Y is an upward force of

(A)   4 N

(B)   5 N

(C)   9 N

(D)   15 N

(E)   19 N

4

S17A
I.2.d
S17C
III.4.b

S 42

A8

(C)

***
–
***

A book is lying on the table. The table is exerting an upward force on the book which is equal to the downward force exerted by the book on the table. This fact illustrates

(A)   Newton's first law

(B)   Newton's second law

(C)   Newton's third law

(D)   Newton's law of universal gravitation

(E)   that mass and weight are the same

WORK AND

KINETIC ENERGY

1   In which case below is work <u>not</u> being done?

S17A   (A)   pushing against an immovable wall
I.3.a
S17C   (B)   pushing a car a distance of 0.5 km
III.5.a
         (C)   walking down a flight of stairs
S 45
         (D)   playing a violin in an orchestra
A2
         (E)   gliding to a stop on roller skates
(A)

**
-
**

2   Consider the four units given below.

S17A   I. $kg \cdot m/s^2$
I.3.a
S17C   II.   J
III.5.a
            III. $N \cdot m$
46
             IV. $kW \cdot h$
A2
         Which of the above are units of energy?
(D)
         (A)   I and II only
***
-        (B)   II and III only
***
         (C)   II and IV only

         (D)   II, III and IV only

         (E)   all are units of energy

3   One joule is equivalent to one

S17A   (A)   newton metre
I.3.a
S17C   (B)   newton per metre
III.5.a
             (C)   joule second
46
             (D)   joule per second
A2
             (E)   newton per second
(A)

***
—
***

4   The joule is a unit of

S17A   (A)   current
III.2.h
S17C   (B)   energy
III.5.a
             (C)   potential
46
             (D)   power
A2
             (E)   resistance
(B)

*
—
**

5   The SI unit of energy is the

S17A   (A)   kg
I.3.a
S17C   (B)   N
III.5.a
             (C)   J
46
             (D)   W
A2
             (E)   kW·h
(C)

**
—
**

6   The SI unit of work is the

S17A   (A)   newton
I.3.a
S17C   (B)   newton per metre
III.5.a
            (C)   joule
46
            (D)   joule metre
A4
            (E)   joule per second
(C)

*
-
*

7   An object's energy can be expressed in

S17A   (A)   N·J
I.3.a
S17C   (B)   N·s
III.5.a
            (C)   J·s
46
            (D)   N·m
A4
            (E)   kW
(D)

***
-
***

8   The derived unit for energy is the

S17A   (A)   joule metre
I.3.a
S17C   (B)   kilogram metre
III.5.a
            (C)   newton joule
46
            (D)   newton metre
A4
            (E)   joule second
(D)

***
-
***

9

S17A
I.3.a
S17C
III.5.a

46
S 48
S 4

A4

(B)

**

-

***

The SI derived unit with a special name for energy is the

(A) hertz

(B) joule

(C) newton

(D) newton metre

(E) watt

10

S17A
I.3.a
S17C
III.5.a

46

A8

(D)

***

-

***

Which of the following is <u>not</u> an expression of energy?

(A) $\frac{1}{2}mv^2$

(B) Fd

(C) mgd

(D) P/t

(E) mad

11

S17A
I.3.b
S17C
III.5.b

S 46

A2

(B)

***

-

***

Which of the following is <u>not</u> a vector quantity?

(A) acceleration

(B) energy

(C) force

(D) velocity

(E) weight

12   One newton metre is equivalent to one

S17A   (A)   hertz
I.3.d
S17C   (B)   joule
III.6.f
            (C)   metre per newton
S 46
48   (D)   newton per metre

A2   (E)   watt

(B)

**
-
**

13   Select the scalar quantity from the following list.

S17A   (A)   acceleration
I.3.a
S17C   (B)   displacement
III.5.a
            (C)   force
S 46
S 35   (D)   velocity

A2   (E)   work
A6

(E)

***
-
***

14   Select a unit of measurement from the following list.

S17A   (A)   acceleration
-I.3.a
S17C   (B)   energy
III.6.f
            (C)   force
S 46
S 31   (D)   joule

A2   (E)   work
A6

(D)

*
-
*

15   Select the scalar quantity from the following list.

S17A   (A)   acceleration
I.3.a
S17C   (B)   displacement
III.5.a
              (C)   energy
S 46
              (D)   force
A3
A6   (E)   velocity

(C)

***
−
***

16   Select the vector quantity from the following list.

S17A   (A)   distance
I.3.a
S17C   (B)   energy
III.5.a
              (C)   mass
S 46
              (D)   time
A3
A6   (E)   velocity

(E)

***
−
***

17   The derived unit with a special name for work or
              energy is the joule (J). The derived unit with
S17A   a compound name for work or energy is the
I.3.a
S17C   (A) $kg \cdot m/s^2$
III.5.a
              (B) $N \cdot m^2$
S 46
              (C) N/m^2
A4
              (D) $N \cdot m$
(D)
              (E) N/m
***
−
***

18

Select a unit of measurement from the following list.

S17A
I.3.b   (A)   energy
S17C
III.5.a   (B)   mass

S 46   (C)   newton
S 35
S 15   (D)   velocity

A6   (E)   work

(C)

**
-
***

19

Work is <u>always</u> done when

S17A   (A)   an object has potential energy
I.3.a
S17C   (B)   an object moves
III.5.a
               (C)   a force is applied perpendicular to the
47   direction an object moves

A3   (D)   a force moves an object
A8
               (E)   a force is exerted on an object
(D)

***
-
***

20

The work done on an object is calculated by

S17A   (A)   dividing the force applied by the distance
I.3.a   travelled
S17C
III.5.a   (B)   dividing the force applied by the distance
                     travelled in the direction of the force
47
               (C)   multiplying the force applied by the distance
A8   travelled

(E)   (D)   multiplying the force applied by the distance
                     travelled and dividing by the time taken
***
-              (E)   multiplying the force applied by the distance
***   travelled in the direction of the force

21

S17A
I.3.a
S17C
III.5.a

47

F1

(A)

***
–
***

A net force of 90.0 N does 45.0 J of work on a brick. What is the magnitude of the displacement of the brick?

(A)   0.500 m

(B)   2.00 m

(C)   45.0 m

(D)   135 m

(E) 4.05×10^3 m

22

S17A
I.3.a
S17C
III.5.a

47

F1
A3

(A)

***
–
***

A block of metal of mass 50 kg moves through a distance of 12 m on a level, frictionless surface. (g = 10 N/kg)

The minimum work done is
              –

(A)   0

(B) 1.2×10^2 J

(C) 5.0×10^2 J

(D) 6.0×10^2 J

(E) 6.0×10^3 J

23

S17A
I.3.b
S17C
III.5.a

47

F1
A8

(E)

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***

If a 7.00 kg object is lifted 6.00 m vertically upward in 4.00 s, what is the minimum work required? (g = 10.0 N/kg)

(A)   4.20 J

(B)   10.5 W

(C)   42.0 J

(D)   42.0 W

(E)   420 J

24

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(B)

A force of 50 N acts on the block at the angle shown. The block moves a horizontal distance of 3.0 m. The work done is closest to

(A)   0

(B) 1.3×10^2 J

(C) 1.5×10^2 J

(D) 2.7×10^2 J

(E) 4.5×10^2 J

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***
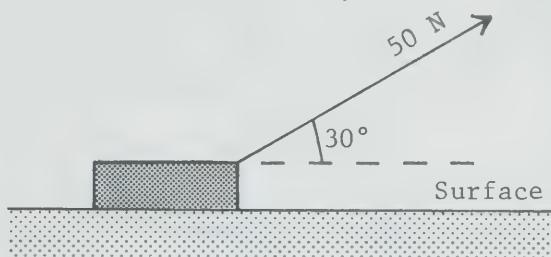
25

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(E)

A 70 N weight rests on a platform 2.0 m high. The work done by the platform to support the weight is

(A) 1.4×10^3 J

(B) 1.4×10^2 J

(C)   70 J

(D)   35 J

(E)   0

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26

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(B)

If a force of 6.0 N acts for a distance of 7.0 m, how much work is done?

(A)   42 N

(B)   42 J

(C)   1.2 N

(D)   1.2 J

(E)   0.86 J

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*

27

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(D)

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***

In moving an object 7.0 m, 40 J of energy are
expended. The average force exerted is closest to

(A) 2.8×10^2 N

(B)   47 N

(C)   28 N

(D)   5.7 N

(E)   0.18 N

28

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(D)

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***

In moving an object 7.0 m, 50 J of work are done.
The average force exerted is closest to

(A) 3.5×10^2 J

(B)   57 N

(C)   43 N

(D)   7.1 N

(E)   0.14 N

29

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(A)

**
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***

A person did 5 400 J of work in pushing a car a
distance of 60 m. What average force did the
person exert?

(A)   90 N

(B)   9.0 N

(C)   0.011 N

(D) 5.4×10^3 J

(E) 3.2×10^5 J

30

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(C)

**
-
**

A force of 25 N moves a 3.0 kg mass through a distance of 2.0 m in a straight line. The work done by the force is

(A) 1.5×10^2 J

(B)   75 J

(C)   50 J

(D)   17 J

(E)   6.0 J

31

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(D)

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-
***

In moving an object 7.0 m, 40 J of energy are expended. The average force exerted is

(A) 2.8×10^2 N

(B)   47 N

(C)   33 N

(D)   5.7 N

(E)   0.18 N

32

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(E)

**
-
**

A horse pulls a wagon with a force of 200 N for a distance of 80 m. How much work does the horse do?

(A)   2.5 J

(B) 1.2×10^2 J

(C) 2.8×10^2 J

(D) 1.6×10^3 J

(E) 1.6×10^4 J

33

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(E)

*
–
**

A horse pulls a wagon with a force of 200 N for a distance of 80.0 m. How much work does the horse do?

(A)   0.400 J

(B)   2.50 J

(C)   120 J

(D)   80.0 x 10^2 J

(E)   160 x 10^2 J

34

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(D)

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***

In moving an object 7.00 m, 40.0 J of energy are expended. The average force exerted is

(A)   280 N

(B)   47.0 N

(C)   33.0 N

(D)   5.71 N

(E)   0.175 N

35

S17A
I.3.a
S17C
III.5.a

47

F1
A8

(D)

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***

A 400 kg piano is pushed 2.00 m across a floor. The force required is 600 N. The work done is

(A)   400 J

(B)   600 J

(C)   800 J

(D)   1.20 x 10^3 J

(E)   4.80 x 10^5 J

36   In moving an object 7.0 m, 42 J of energy are
               expended. The average force exerted is

S17A
I.3.a   (A) 2.8×10^2 N
S17C
III.5.a   (B)   47 N

47   (C)   33 N

F1   (D)   6.0 N
A10
               (E)   0.20 N

(D)

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-
***

37   A net force of 90.0 N does 45.0 J of work on a
               brick. What is the magnitude of the displacement
S17A   of the brick?
I.3.a
S17C   (A)   0.500 m
III.5.a
               (B)   2.00 m
S 47
               (C)   20.0 m
F1
A8   (D)   45.0 m

(A)   (E) 4.05×10^3 m

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-
***

38   The J/s is a unit of

S17A   (A)   work
I.3.d
S17C   (B)   energy
III.6.c
               (C)   force
48
               (D)   power
A2
               (E)   velocity
(D)

***
-
***

39 Which one of the following is equal to one watt?

S17A   (A) 1 kg·m/s
I.3.d
        (B) 1 kg·m/s^3
48
        (C) 1 kg·m^2/s
A2
        (D) 1 kg·m^2/s^3
(D)
        (E) 1 kg·m^2/s^2
***
-
***

40 One watt is equivalent to one

S17A   (A) newton metre
I.3.d
        (B) newton per metre
48
        (C) joule second
A2
        (D) joule per second
(D)
        (E) newton per second
*
-
**

41 The SI derived unit of power with a special name
        is the
S17A
I.3.d   (A) hertz

48   (B) joule

A2   (C) newton

(E)   (D) pascal

**   (E) watt
-
**

42   Power is

S17A   (A)   force applied per unit time
I.3.d
              (B)   energy used per unit time
48
              (C)   expressed in joules per metre
A2
              (D)   time taken divided by work done
(B)
              (E)   work done multiplied by time taken
**
‒
**

43   A watt equals one

S17A   (A) $\dfrac{kg \cdot m}{s^2}$
I.3.d

48   (B) $\dfrac{kg \cdot m^2}{s}$

A4
              (C) $\dfrac{kg \cdot m^2}{s^3}$
(C)

***   (D) $\dfrac{kg \cdot m}{s^3}$
‒
***
              (E) $\dfrac{kg \cdot m^2}{s^2}$

44   Which one of the following is a unit of power?

S17A   (A)   joule
I.3.d
              (B)   kilowatt
48
              (C)   kilowatt hour
A4
              (D)   newton
(B)
              (E)   joule second
**
‒
***

45   Which of the following is equal to one watt?

S17A   (A)   1 N·s
I.3.d
           (B)   1 N/s
48
           (C)   1 J·s
A4
A2   (D)   1 J/s

(D)   (E)   1 N·m

*
‒
**

46   Which one of the following is a unit of power?

S17A   (A)   N/s
I.3.d
           (B)   N·s
48
           (C)   W·s
A4
A2   (D)   J/s

(D)   (E)   J·s

**
‒
**

47   Which of the following terms is a unit of
           measurement?
S17A
I.3.d   (A)   acceleration

S 48   (B)   energy

A2   (C)   force

(E)   (D)   power

**   (E)   watt
‒
***

48

S17A

I.2.a

S 48

A2

(A)

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***

Which of the following quantities is a vector quantity?

(A) average velocity

(B) instantaneous speed

(C) kinetic energy

(D) maximum power

(E) total distance

49

S17A
I.3.d
S17C
III.6.f

S 48
S 46
S 35

A2

(D)

**
-
***

The SI derived unit with a special name for force is the

(A) hertz

(B) joule

(C) kilogram metre per second squared

(D) newton

(E) watt

50

S17A
I.3.d

S 48

A2
A3

(D)

*
-
*

Which one of the following is a unit of measurement?

(A) acceleration

(B) energy

(C) force

(D) kilogram

(E) power

51   Which of the following is equivalent to 1 $kg \cdot m^2/s^3$?

S17A   (A)   one hertz
I.3.d
              (B)   one joule
S 48
              (C)   one newton
A2
A11   (D)   one watt

(D)   (E)   none of the above

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52   Which of the following is equivalent to 1 J/s?

S17A   (A)   one hertz
I.3.d
              (B)   one joule
S 48
              (C)   one newton
A2
A11   (D)   one watt

(D)   (E)   none of the above

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53   Which of the following is equivalent is 1 $kg \cdot m/s^2$?

S17A   (A)   one hertz
I.3.d
              (B)   one joule
S 48
              (C)   one newton
A2
A11   (D)   one watt

(C)   (E)   none of the above

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***

54   One watt equals

S17A   (A)   1 kg·m/s^2
I.3.d
            (B)   1 kg·m/s^3
S 48
            (C)   1 kg·m^2/s
A2
A11   (D)   1 kg·m^2/s^2

(E)   (E)   1 kg·m^2/s^3

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***

55   Which of the following is equivalent to 1 N·m?

S17A   (A)   one hertz
I.3.d
            (B)   one joule
S 48
            (C)   one newton
A2
A11   (D)   one watt

(B)   (E)   none of the above

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***

56   Which of the following is equivalent to 1 kg·m/s?

S17A   (A)   one hertz
I.3.d
            (B)   one joule
S 48
            (C)   one newton
A2
A11   (D)   one watt

(E)   (E)   none of the above

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**

57   Which of the following is equivalent to 1 J·s?

S17A   (A)   one hertz
I.3.d
            (B)   one joule
S 48
            (C)   one newton
A2
A11   (D)   one watt

(E)   (E)   none of the above

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***

58   Which of the following is equivalent to 1 kg·m^2/s^2?

S17A   (A)   one hertz
I.3.d
            (B)   one joule
S 48
            (C)   one newton
A2
A11   (D)   one watt

(B)   (E)   none of the above

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***

59   Which of the following is equivalent to 1 kg·m/s^3?

S17A   (A)   one hertz
I.3.d
            (B)   one joule
S 48
S 46   (C)   one newton

A2   (D)   one watt
A11
            (E)   none of the above
(E)

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***

60

S17A
I.3.d

49

A8
F1

(A)

**

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***

A 30 N force moves a mass through a distance of 10 m in 20 s. The power is

(A)   15 W

(B)   60 W

(C) 3.0×10^2 W

(D) 6.0×10^2 W

(E) 6.0×10^3 W

61

S17A
I.3.d

49

F1
A8
A2

(A)

***

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***

A man pushed a stalled car with a 100 N force and moved it 0.50 m in 2.0 s. The power used by the man was

(A) 2.5×10^1 W

(B) 5.0×10^1 W

(C) 1.0×10^2 W

(D) 4.0×10^2 W

(E) 5.0×10^2 W

62

S17A
I.3.d

49

F1
A8

(D)

**

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***

A power supply produces 60 W for 10 s. The energy supplied is

(A)   0.17 J

(B)   6.0 W

(C)   6.0 J

(D) 6.0×10^2 J

(E) 6.0×10^2 kW

63

S17A
I.3.d

49

F1
A8

(E)

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***

A load of mass 80 kg is lifted to a height of 4.0 m in 2.0 min. ($g = 10$ m/s^2)

The minimum power of the lifting device is

(A) 6.4×10^3 W

(B) 3.2×10^3 W

(C) 1.6×10^3 W

(D) 3.2×10^2 W

(E) 2.7×10^1 W

64

S17A
I.3.d

49

F1
A8

(D)

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***

A machine with a power rating of 15.0 kW must complete a job requiring an expenditure of 1.50×10^5 J of energy. How long will it take to complete the job?

(A) 2.25×10^6 s

(B) 1.00×10^4 s

(C) 1.00×10^2 s

(D) 1.00×10^1 s

(E) 1.00 s

65

S17A
I.3.d

49

F1
A8

(C)

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**

An elevator is powered by an electric motor which can lift a 25.0 kg object a distance of 15.0 m in 10.0 s. ($g = 10.0$ N/kg)

The power of the motor must be at least

(A) 2.50×10^3 W

(B) 1.50×10^3 W

(C) 375 W

(D) 250 W

(E) 150 W

66

S17A
I.3.d

49

F1
A8

(C)

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***

A mass of 100 kg of water falls 30.0 m every 15.0 s
to turn a paddle wheel. What is the maximum power
of the falling water? (g = 10.0 N/kg)

(A)   200 W

(B)   500 W

(C)   2.00 kW

(D)   30.0 kW

(E)   450 kW

67

S17A
I.3.d

49

F1
A8

(A)

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A 30 kg carton of books is carried up a flight of
stairs 4.0 m high. (g = 10 N/kg)

If the time required is 1.0 min, the power required
is approximately

(A)   2.0 x 10 W

(B)   1.2 x 10^2 W

(C)   4.5 x 10^2 W

(D)   1.2 x 10^3 W

(E)   4.5 x 10^3 W

68

S17A
I.3.d

49

F1
A8

(B)

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***

A 20 kg load of shingles is carried a vertical
height of 8.0 m up a ladder in 40 s. (g = 10 N/kg)

The power generated is approximately

(A)   4.0 W

(B)   4.0 x 10^1 W

(C)   1.0 x 10^2 W

(D)   2.0 x 10^2 W

(E)   6.4 x 10^3 W

69   An engine does 1.2×10^4 J of work in 6.0×10^1 min.
              The power developed is

S17A
I.3.d   (A) 7.2×10^5 W

49   (B) 1.2×10^4 W

F1   (C) 2.0×10^2 W
A8
              (D)   3.3 W
(D)
              (E) 3.0×10^{-1} W

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***

70   Which one of the following is <u>not</u> an expression for
              energy?

S17A
I.3.d   (A) mgh
S17C
III.6.f   (B) Fd

S 49   (C) $\frac{1}{2}mv^2$

A8   (D) ma

(D)   (E) Pt

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***

71   Kinetic energy is

S17A   (A)   energy due to the motion of a mass
I.3.b
S17C   (B)   energy due to the position of a mass
III.6.f
              (C)   gravitational energy of a mass
51
              (D)   latent energy of a mass
A2
              (E)   heat energy of a mass
(A)

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**

72   Kinetic energy is <u>not</u> possessed by

S17A   (A) a bullet moving in a parabolic path at its
I.3.b   highest point
S17C
III.6.f   (B) the propeller of a plane during flight

51   (C) a pendulum in the middle of its swing

A3   (D) an elevator standing at the fifth floor
A2
            (E) the earth moving around the sun
(D)

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73   A perpetual motion machine does not exist because

S17A   (A) government patent offices will no longer accept
I.3.c   patent applications for such a machine
S17C
III.6.b   (B) energy can only be destroyed, not created

S 52   (C) such devices are not permitted by governments

A9   (D) friction cannot be entirely eliminated

(D)   (E) objects have a natural tendency to come to rest

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***

74   A basketball having a mass of 2.00 kg is given a
            velocity of 15.0 m/s. The kinetic energy of the
S17A   basketball is
I.3.b
S17C   (A) 2.00 J
III.5.b
            (B) 15.0 J
53
            (C) 30.0 J
A8
F1   (D) 225 J

(D)   (E) 450 J

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75

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(B)

An athlete competing in the shot put event throws a 5.0 kg shot at a speed of 8.0 m/s. The shot has been given a kinetic energy of

(A) 3.2×10^2 J

(B) 1.6×10^2 J

(C) 80 J

(D) 40 J

(E) 20 J

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76

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(B)

A one kilogram object falls from a height of 20 m. ($g = 10$ m/s^2)

Just before hitting the ground, its speed is

(A) 6.3 m/s

(B) 20 m/s

(C) 40 m/s

(D) 2.0×10^2 m/s

(E) 4.0×10^2 m/s

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77

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(B)

A baseball of mass 0.30 kg has a velocity of 40 m/s. It has a kinetic energy of

(A) 4.8×10^2 J

(B) 2.4×10^2 J

(C) 1.2×10^2 J

(D) 7.2×10^1 J

(E) 6.0 J

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78

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(B)

A bullet is fired from a gun with a speed of
1 000 cm/s. If the bullet has a mass of 0.01 kg,
it possesses a kinetic energy of

(A) 0.05 J

(B) 0.5 J

(C) 1 J

(D) 5 J

(E) 5×10^3 J

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79

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(D)

Increasing a car's speed from 25.0 km/h to 100 km/h
increases its kinetic energy by a factor of

(A) 3.00

(B) 4.00

(C) 9.00

(D) 16.0

(E) 75.0

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80

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(D)

A bird of mass 2.0 kg is flying at a speed of
5.0 m/s. Its kinetic energy is

(A) 5.0 J

(B) 10 J

(C) 20 J

(D) 25 J

(E) 50 J

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81   A bird of mass 1.6 kg is flying at a speed of 15 m/s.
           Its kinetic energy is

S17A
I.3.b   (A)   12 J
S17C
III.5.b   (B)   24 J

53   (C) 1.8×10^2 J

F1   (D) 2.4×10^2 J
A8
            (E) 3.6×10^2 J
(C)

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82   The kinetic energy of a 0.18 kg volleyball thrown
           with a speed of 11 m/s is

S17A
I.3.b   (A)   0.18 J
S17C
III.5.b   (B)   0.36 J

53   (C)   5.6 J

F1   (D)   11 J
A8
            (E)   22 J
(D)

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83   A shot put of mass 5.0 kg is heaved with a speed
           of 8.0 m/s. It is given a kinetic energy of

S17A
I.3.b   (A) 3.2×10^2 J
S17C
III.5.b   (B) 1.6×10^2 J

53   (C)   80 J

F1   (D)   40 J
A8
            (E)   20 J
(B)

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***

84

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(D)

A shotput of mass 5.0 kg is heaved with a speed of 8.0 m/s. This gives it a kinetic energy of

(A)   6.4 J

(B)   40 J

(C)   80 J

(D) 1.6×10^2 J

(E) 3.2×10^2 J

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85

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(C)

The kinetic energy of a 0.40 kg hockey puck moving at 40 m/s is

(A)   8.0 J

(B) 1.3×10^2 J

(C) 3.2×10^2 J

(D) 6.4×10^2 J

(E) 8.0×10^2 J

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86

S17A
I.3.b
S17C
III.5.b

53

F1
A8

(C)

The kinetic energy of a 0.360 kg football thrown at 18.0 m/s is

(A)   3.20 J

(B)   6.50 J

(C)   58.0 J

(D)   117 J

(E)   233 J

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87

S17A
I.3.d
S17C
III.5.b

53

F1
A8

(B)

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**

Two trailers, X with a mass of 500 kg, and Y with a mass of 2000 kg, are being pulled at the same speed. What is the ratio of the kinetic energy of Y to the kinetic energy of X?

(A)   2:1

(B)   4:1

(C)   9:1

(D)   16:1

(E)   1500:1

88

S17A
I.3.d
S17C
III.5.b

53

F1
A8

(D)

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***

A baseball of mass 0.200 kg has a speed of 31.0 m/s. Its kinetic energy is

(A)   3.10 J

(B)   6.20 J

(C)   12.4 J

(D)   96.1 J

(E)   192 J

89   The kinetic energy of a 1.5 kg bowling ball is 12 J.
              Its velocity is

S17A
I.3.d   (A)   2.0 m/s
S17C
III.5.b   (B)   2.8 m/s

53   (C)   4.0 m/s

F1   (D)   8.0 m/s
A8
              (E)   18 m/s
(C)

***
–
***

90   A bird of mass 1.6 kg is flying at a speed of 15 m/s.
               Its kinetic energy is

S17A
I.3.d   (A)   12 J
S17C
III.5.b   (B)   24 J

53   (C) 1.4×10^2 J

F1   (D) 1.8×10^2 J
A8
              (E) 3.6×10^2 J
(D)

***
–
***

1   Energy is the force of gravity on an object.

S17A   (A)   True
I.3.a
S17C   (B)   False
III.5.a

45

A2

(B)

2   Energy is the ability to do work.

S17A   (A)   True
I.3.a
S17C   (B)   False
III.5.a

45

A2

(A)

3   The unit for energy expressed in base units is the
           $kg \cdot m^2/s^2$.
S17A
I.3.a   (A)   True
S17C
III.5.a   (B)   False

46

A2
A4
A11

(A)

***
—
***

4   The unit for energy is the same as the unit for
             work.

S17A
I.3.a   (A)   True
S17C
III.5.a   (B)   False

46

A2

(A)

**
-
***

5   The joule second is a unit of power.

S17A   (A)   True
I.3.d
            (B)   False

48

A2
A4

(B)

***
-
***

6   Energy is measured in watts.

S17A   (A)   True
I.3.a
S17C   (B)   False
III.5.a

S 48

A2

(B)

7

S17A
I.3.d

49

F1
A8

(A)

**

—

***

A 40 W light bulb left on for 5 min consumes the
same quantity of electrical energy as a 100 W bulb
left on for 2 min.

(A)   True

(B)   False

8

S17A
I.3.d

49

F1
A8

(A)

***

—

***

If a 25 W light bulb is left on for 2 min, it will
consume more than 2500 J of electrical energy.

(A)   True

(B)   False

9

S17A
I.3.b
S17C
III.5.b

53

A3
A5
A8

(B)

**

—

***

If the speed of an automobile is doubled, its kinetic
energy is doubled.

(A)   True

(B)   False

10   If $E_k = \frac{1}{2}mv^2$, then $v = \pm\sqrt{\dfrac{E_k}{2m}}$.

S17A
I.3.b   (A)   True
S17C
III.5.b   (B)   False

53

A4

(B)

**
–
**

11   If $E_k = \frac{1}{2}mv^2$, then $v = \pm\sqrt{\dfrac{m}{2E_k}}$.

S17A
I.3.b   (A)   True
S17C
III.5.b   (B)   False

53

A4

(B)

**
–
*

12   If object A has three times the mass of object B and
                both are moving with the same speed, object A has
S17A   nine times the kinetic energy of object B.
I.3.b
S17C   (A)   True
III.5.b
                (B)   False
53

F1
A3
A8

(B)

**
–
**

13   An object of mass m moving with a speed of 2 v has
            the same kinetic energy as an object of mass 1/2 m
S17A   moving with a speed of 4 v.
I.3.b
S17C   (A)   True
III.5.b
            (B)   False
53

F1
A8
A3

(B)

***
–
***

14   The kinetic energy of a 60.0 kg football player
            running at 5.00 m/s is 750 J.
S17A
I.3.b   (A)   True
S17C
III.5.b   (B)   False

53

F1
A8
A3

(A)

***
–
***

GRAVITATIONAL

POTENTIAL ENERGY

1

S17A
I.3.b
S17C
III.6.c

55

A8

(E)

***
–
***

What minimum work is required to lift a 14 kg mass a distance of 7.0 m? (g = 10 N/kg)

(A) 9.8 J

(B) 21 J

(C) 98 W

(D) 98 J

(E) 9.8 x 10^2 J

2

S17A
I.3.b
S17C
III.6.c

55

A8
F1

(E)

**
–
***

What is the potential energy of a 1.6 kg partridge on a branch in a pear tree 13 m above the ground? (g = 10 N/kg)

(A) 2.1 J

(B) 1.6 x 10^1 J

(C) 2.1 x 10^1 J

(D) 1.6 x 10^2 J

(E) 2.1 x 10^2 J

3

S17A
I.3.b
S17C
III.6.c

55
53

F1
A8

(C)

***
–
***

A 20 kg mass is lifted to a height of 8.0 m above the earth and then moved sideways at a constant speed of 10 m/s. What is the kinetic energy of the mass if g = 10 N/kg?

(A) 1.0×10^2 J

(B) 8.0×10^2 J

(C) 1.0×10^3 J

(D) 1.6×10^3 J

(E) 2.6×10^3 J

4

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(B)

**
–
***

A golf ball is hit from X toward the green at the top of a hill as shown below.

path of golf ball   green

X

The potential energy of the golf ball is greatest when it

(A)   leaves the golf club

(B)   reaches the highest point in its flight

(C)   first hits the green

(D)   bounces off the green

(E)   comes to rest on the other side of the green

5

S17A
I.3.b
S17C
III.5.c

55

F1
A8

(A)

**

—

***

A mass of 30 kg is lifted at a steady speed from the ground to a platform 1.5 m above the ground. (g = 10 N/kg)

The work done on the mass is

(A) 4.5×10^2 J

(B) 2.0×10^2 J

(C)   45 J

(D)   20 J

(E)   4.5 J

6

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(C)

***

—

**

In the accompanying diagram, point X indicates the position of the bob of a long pendulum of mass 2.0 kg which has been pulled aside.   (g = 10 N/kg)

The gravitational potential energy of the bob with respect to point Y is clos-est to

(A)   8.0 J

(B)   40 J

(C)   80 J

(D) 2.0×10^2 J

(E) 2.2×10^2 J

7

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(E)

**

—

***
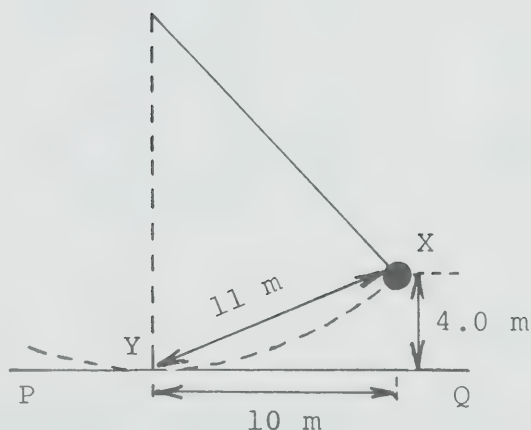
A 12 kg mass is located 4.0 m above the floor.
($g = 10$ N/kg)

The potential energy of the mass with respect to
the floor is

(A)   3.0 J

(B)   30 J

(C)   48 J

(D) 1.2×10^2 J

(E) 4.8×10^2 J

8

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(C)

***

—

***

A girl exerts a 200 N force to lift a barbell to a
vertical height of 2.0 m in 5.0 s. If she had done
this in 10 s, the energy required would have been

(A)   four times as great

(B)   twice as great

(C)   the same

(D)   half as great

(E)   one quarter as great

9

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(C)

**

—

***

A model airplane of mass 1.5 kg moves with a speed
of 3.0 m/s, 5.0 m above the ground. ($g = 10$ m/s^2)

The airplane has a potential energy of

(A)   6.8 J

(B)   38 J

(C)   75 J

(D)   80 J

(E)   82 J

10

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(C)

***
-
***

A ramp leading up to a loading platform is 3.0 m
long and 1.0 m high at its highest point.
(g = 10 N/kg)

If friction is ignored, what minimum force is
needed to slide a 600 kg crate up the ramp?

(A) 2.0×10^2 kg

(B) 1.8×10^3 kg

(C) 2.0×10^3 N

(D) 3.0×10^3 N

(E) 6.0×10^3 N

11

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(E)

**
-
***

A workman on the CN Tower in Toronto dropped a
2.0 kg wrench. The wrench fell 300 m to the
ground. (g = 10 N/kg)

The work done by the force of gravity on the
wrench was

(A) 1.5×10^2 J

(B) 6.0×10^2 J

(C) 1.5×10^3 J

(D) 3.0×10^3 J

(E) 6.0×10^3 J

12

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(C)

***
-
***

A baseball is thrown upward with a speed of 20 m/s.
(Assume g = 10 m/s^2.)

The ball will rise to a maximum height of

(A)   80 m

(B)   30 m

(C)   20 m

(D)   10 m

(E)   1.0 m

13

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(D)

**

—

***

The ball at the top of a 10 m flag pole has a mass of 0.50 kg. (Assume g = 10 N/kg.)

The potential energy of the ball with respect to the ground is

(A)   0.50 J

(B)   5.0 J

(C)   25 J

(D)   50 J

(E) 1.0×10^2 J

14

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(A)

**

—

***

What is the potential energy of a bird of mass 1.5 kg perched 8.0 m above the ground? (Assume g = 10 N/kg.)

(A) 1.2×10^2 J

(B) 8.0×10^1 J

(C) 2.2×10^1 J

(D) 1.5×10^1 J

(E) 1.2×10^1 J

15

S17A
I.3.b
S17C
III.6.c

55

F1
A8

(D)

***

—

***

A girl exerts a 200 N force to lift a barbell to a vertical height of 2.0 m in 5.0 s. If she had done this in 10 s, the energy required would have been

(A)   five times as great

(B)   four times as great

(C)   twice as great

(D)   the same

(E)   half as great

16

S17A
I.3.b
S17C
III.6.c

55
53

F1

(D)

**

–

***

A 20 kg mass is lifted to a height of 8.0 m above the earth and then moved sideways at a constant speed of 10 m/s. What is the gravitational potential energy of the mass if g = 10 N/kg?

(A) 1.0×10^2 J

(B) 8.0×10^2 J

(C) 1.0×10^3 J

(D) 1.6×10^3 J

(E) 2.6×10^3 J

17

S17A
I.3.b
S17C
III.6.c

55
47

F1
A8

(E)

***

–

***

What is the minimum work done when a mass of 100 kg is lifted vertically 10 m? (g = 10 m/s^2)

(A) 1.0 J

(B) 1.0×10^1 J

(C) 1.0×10^2 J

(D) 1.0×10^3 J

(E) 1.0×10^4 J

18

S17A
I.3.c
S17C
III.6.f

56

A8

(C)

**

—

**

A ball is thrown into the air and moves as shown in the diagram below. Five positions of the ball are shown.
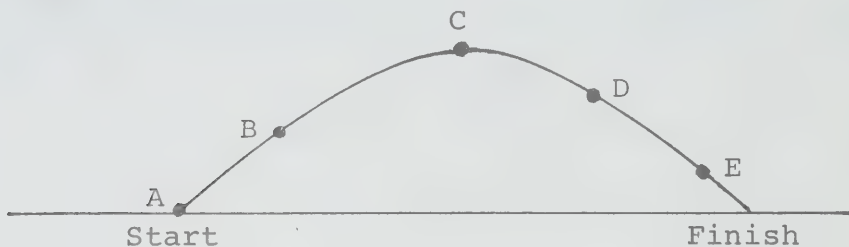
Where does the ball have its maximum potential energy?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

19

S17A
I.3.c
S17C
III.6.f

56

A8

(A)

***

—

***

A ball is thrown into the air and moves as shown in the diagram below. Five positions of the ball are shown.
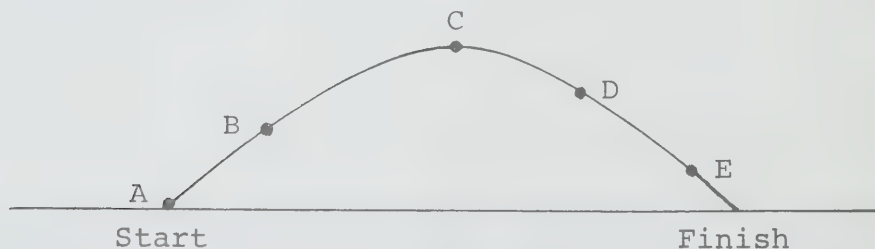
Where does the ball have the maximum kinetic energy?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

20

A ball is thrown vertically upward. Which one of
the following quantities increases as the ball rises?

S17A

I.3.c   (A)   force of gravity

S17C

III.6.f   (B)   potential energy

56   (C)   kinetic energy

A5   (D)   speed

(B)   (E)   weight

**

−

***

21

A baseball of mass m is moving with a speed v at a
height h above the ground where the acceleration due

S17A   to gravity is g.

I.3.c

S17C   Which of the following quantities are needed to

III.6.b   determine the total mechanical energy of the baseball?

56   (A) h and m only

A8   (B) g, h and m only

(E)   (C) m and v only

             (D) g, m and v only

             (E) g, h, m and v

22

A 6.0 kg mass is released from rest at a height of
80 m. If air resistance is negligible and

S17A $g = 10$ N/kg, the kinetic energy of the mass when

I.3.c   it has fallen 60 m is

S17C

III.6.b   (A) 4.8×10^3 J

56   (B) 3.6×10^3 J

A8   (C) 1.2×10^3 J

(B)   (D) 1.2×10^2 J

***   (E)   zero

−

***

23

S17A
I.3.c
S17C
III.6.f

56

A8
A5

(A)

**

—

***

If friction is neglected, when an object falls from a position 300 m high, its total energy

(A)   remains constant during the fall

(B)   increases during the fall

(C)   decreases during the fall

(D)   is zero at the start of the fall

(E)   is a maximum at the end of the fall

24

S17A
I.3.b
S17C
III.6.b

56

F1
A3

(D)

***

—

***

A cyclist coasts from rest down a steep hill. Neglecting friction, as the cyclist coasts down the hill, which one of the following statements is <u>false</u>?

(A)   The gravitational potential energy of the student decreases.

(B)   The mechanical energy of the student stays constant.

(C)   The loss in gravitational potential energy always equals the gain in kinetic energy.

(D)   The gravitational potential energy always equals the kinetic energy.

(E)   The kinetic energy of the student increases.

25

S17A
I.3.b
S17C
III.6.f

56

F1
A8

(E)

**

—

***

As a rocket-powered spacecraft accelerates from the launch pad, it gains

(A)   height and speed only

(B)   height and gravitational potential energy only

(C)   speed and gravitational potential energy only

(D)   height, speed and gravitational potential energy only

(E)   height, speed, gravitational potential energy and kinetic energy

26

S17A
I.3.b
S17C
III.6.b

56

F1
A8

(E)

***
-
***

A box of rivets falls from the top of a skyscraper under construction. As the box passes the 80th floor, it has a kinetic energy of E_k. `By the time it passes the 20th floor its speed has doubled. By then its kinetic energy is

(A) $\frac{1}{4} E_k$

(B) $\frac{1}{2} E_k$

(C) E_k

(D) $2 E_k$

(E) $4 E_k$

27

S17A
I.3.c
S17C
III.6.b

S 56

A2
A5

(D)

***
-
***

A stone is thrown straight up in the air. ($g = 10$ m/s^2)

Which one of the following statements about the stone is <u>false</u>?

(A)   As the stone rises, its kinetic energy decreases.

(B)   As the stone rises, it is accelerated downward.

(C)   As the stone rises, its potential energy increases.

(D)   When the stone reaches the top of its flight, its energy is zero.

(E)   When the stone reaches the top of its flight, its acceleration is still 10 m/s^2.

28

S17A
I.3.c
S17C
III.6.c

S 56

A8

(B)

***
--
***

Which of the following is <u>not</u> an expression for energy?

(A) mgd

(B) ma

(C) $\frac{1}{2}mv^2$

(D) Fd

(E) mad

29

S17A
I.3.c
S17C
III.6.b

S 56

C3
A7

(C)

*
--
**

The following diagrams show different tests you can do with carts on ramps.
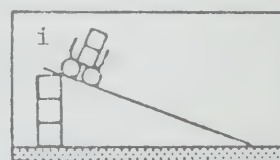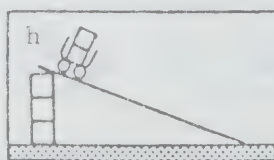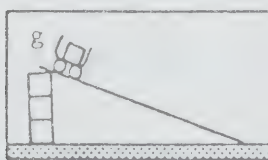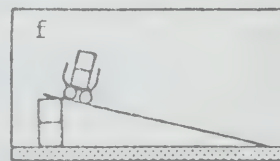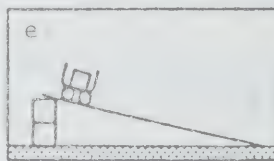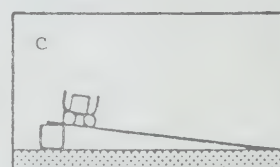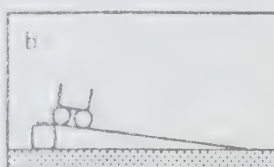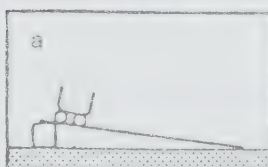
You want to test this idea: the higher a cart starts, the greater its speed at the bottom of the ramp. Which three tests would you use?

(A) a e i

(B) c f i

(C) c e g

(D) a d g

(E) b d h

30

Which of the following is <u>not</u> an expression for energy?

S17A
I.3.c
S17C
III.6.f

S 56

A4
A8

(B)

(A) Fd

(B) ma

(C) mc^2

(D) mgh

(E) $\frac{1}{2}mv^2$

***
-
***

31

The following diagrams show different tests you can do with carts on ramps.

S17A
I.3.c
S17C
III.6.b

S 56

C3
A7

(A)

*
-
**
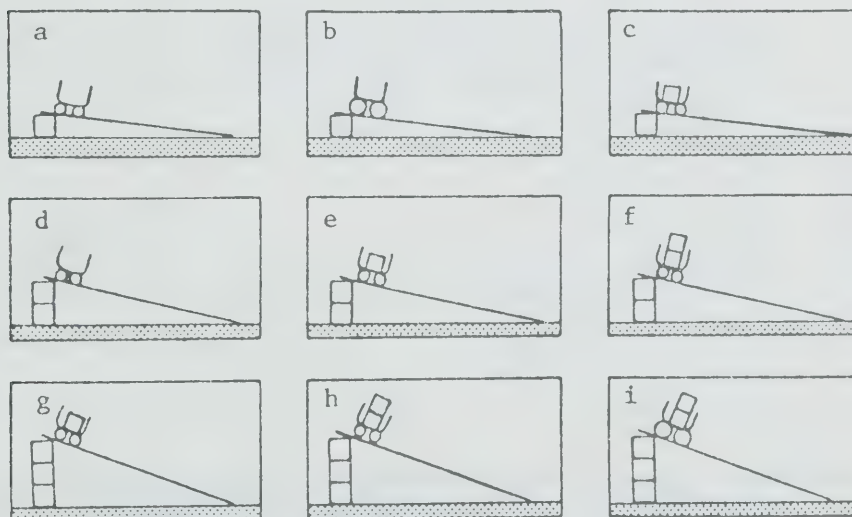
You want to test this idea: a cart with small wheels travels farther after leaving the ramp than a cart with large wheels. Which four tests would you use?

(A)   a b h i

(B)   b c f i

(C)   a b g i

(D)   b c e i

(E)   b d e f

32

S17A
I.3.c
S17C
III.6.b

S 56

C3
A7

(B)

**
-
**

The diagrams below show different tests you can do with carts on ramps.
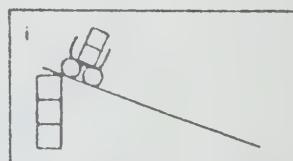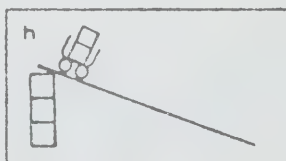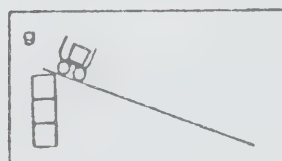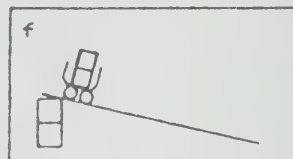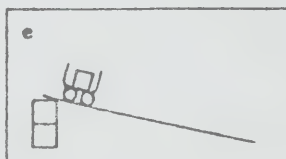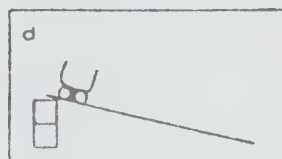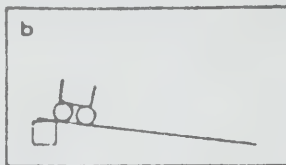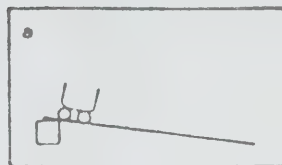
You want to test this idea: the heavier a cart and its load is, the greater its speed at the bottom of the ramp. Which three tests would you use?

(A)   a e h

(B)   d e f

(C)   c f i

(D)   g h i

(E)   a b c

33

S17A
I.3.b
S17C
III.6.f

S 56

F1
A5

(D)

***
-
***

In which of the following is kinetic energy being transformed into potential energy?

(A)   A car accelerating on a level road.

(B)   A raindrop falling freely through the air.

(C)   A curling stone coming to rest on the ice.

(D)   A stone thrown up into the air.

(E)   A bullet fired horizontally from the top of a cliff.

34

S17C

III.6.b

S 56

A1

(C)

**

–

**

A ball is thrown into the air at a 45° angle and moves as shown in the diagram below. Five positions of the ball are shown.
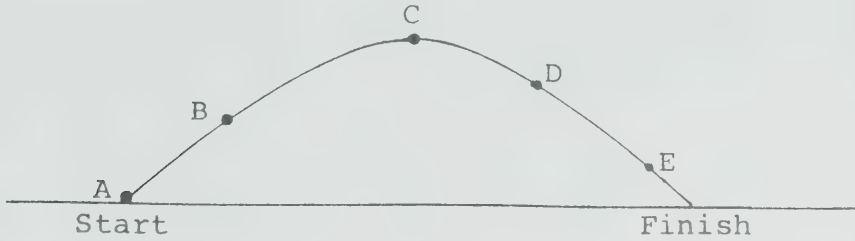
Where is the gravitational potential energy of the ball equal to its kinetic energy?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   E

35

S17A

I.3.b

S17C

III.6.f

S 56

F1

A5

(D)

**

–

***

In which of the following examples is kinetic energy being transformed into potential energy?

(A)   A car accelerating on a level road.

(B)   A body falling freely.

(C)   A train coming to rest by applying brakes.

(D)   A stone thrown up into the air.

(E)   Water turning an electric turbine.

1   In using the gravitational potential energy equation

S17A $E_g = mgh$, h <u>must</u> be measured vertically.
I.3.b
S17C   (A)   True
III.6.c
              (B)   False
55

A2

(A)

*
*
*

2   All freely falling objects lose gravitational
              potential energy at the same rate.
S17A
I.3.b   (A)   True
S17C
III.6.c   (B)   False

56

A1
A10

(B)

***
--
***

BEHAVIOURS OF LIGHT

AND

MODELS OF LIGHT

GEOMETRIC OPTICS

1

S17A
II.3.a
S17C
II.1.a

58

A1

(B)

**
-
***

Which of the following is <u>not</u> a property of light?

(A) It travels faster than sound.

(B) It travels faster in air than in a vacuum.

(C) It travels in a straight line.

(D) It can be bent by refraction.

(E) It is a form of energy.

2

S17A
II.3.a
S17C
II.1.a

58

A2

(A)

***
-
***

A translucent material is one that

(A) transmits images poorly

(B) transmits images clearly

(C) focuses light rays to a point

(D) does not reflect light rays

(E) absorbs all of the light rays

3   Wax paper is

S17A   (A)   fluorescent
II.3.a
S17C   (B)   luminous
II.1.a
                (C)   opaque
58
                (D)   translucent
A2
                (E)   transparent
(D)

**
-
***

4   The image in a pinhole camera is <u>always</u>

S17A   (A)   virtual and inverted
II.3.a
                (B)   virtual and erect
58
                (C)   real and inverted
A2
                (D)   real and erect
(C)
                (E)   smaller than the object
***
-
***

5   A translucent material is one that

S17A   (A)   absorbs all of the incident light
II.3.a
S17C   (B)   reflects all of the incident light
II.1.a
                (C)   either absorbs or reflects all of the incident
58   light

A2   (D)   transmits the incident light to produce a
                        clear image
(E)
                (E)   transmits the incident light to produce a
                        blurred image

6

S17A
II.3.a

58

F1
A2
A8

(E)

***
-
***

A candle flame is 20 cm from a pin-hole camera. If the camera is 15 cm long, then the image will be

(A)   upright, virtual and smaller than the object

(B)   upright, virtual and larger than the object

(C)   inverted, virtual and smaller than the object

(D)   inverted, virtual and larger than the object

(E)   inverted, real and smaller than the object

7

S17A
II.3.a
S17C
II.1.a

59

A1
A2

(D)

***
-
***

A distant object is slowly brought from a great distance toward the centre of curvature of a concave mirror. The image will

(A)   remain virtual and become smaller

(B)   remain virtual and become larger

(C)   remain real and become smaller

(D)   remain real and become larger

(E)   remain real and become a point

8

S17A
II.3.a
S17C
II.1.a

59

A1
A2
A5

(C)

***
-
***

An object located at the centre of curvature of a concave mirror is brought half way to the focus. The image will

(A)   remain virtual and become larger

(B)   remain virtual and become smaller

(C)   remain real and become larger

(C)   remain real and become smaller

(E)   remain real and become the same size as the object

9

S17A
II.3.a
S17C
II.1.a

59

A1
A8

(D)

***
–
***

The image of a candle formed by a convex mirror is <u>always</u>

(A)   virtual, smaller and inverted

(B)   virtual, larger and inverted

(C)   virtual, larger and erect

(D)   virtual, smaller and erect

(E)   real, smaller and erect

10

S17A
II.3.a
S17C
II.1.a

59

A1
A8

(A)

***
–
***

A light ray travelling parallel to the principal axis of a concave mirror hits the mirror. It will be

(A)   reflected through the principal focus

(B)   refracted through the principal focus

(C)   reflected through the centre of curvature

(D)   reflected through the vertex

(E)   reflected back along its original path

11

S17A
II.3.a
S17C
II.1.a

59

A2

(E)

**
–
***

A line is drawn perpendicular to the surface of a concave mirror. Such a line is called

(A)   the angle of incidence

(B)   the centre of curvature

(C)   the principal focus

(D)   the path of light from the image

(E)   the normal at that point on the mirror

12

S17A
II.3.a
S17C
II.1.a

59

A2
A1

(B)

**

—

***

The image of an object, located 2 cm from a plane mirror, is

(A)   virtual and on the surface of the mirror

(B)   virtual and 2 cm behind the mirror

(C)   virtual and 4 cm behind the mirror

(D)   real and 2 cm behind the mirror

(E)   real and 4 cm behind the mirror

13

S17A
II.3.a
S17C
II.1.a

59

A2
A1

(C)

***

—

***

The image in a plane mirror is

(A)   real, erect, and slightly smaller than the object

(B)   real, erect, and the same size as the object

(C)   virtual, laterally inverted, and the same size as the object

(D)   virtual, erect, and slightly larger than the object

(E)   real, laterally inverted, and the same size as the object

14

S17A
II.3.a
S17A
II.1.a

59

A2
A5

(B)

***

—

***

Rays of light originating at the focus of a concave mirror will, after reflection,

(A)   pass back through the focus

(B)   travel parallel to the principal axis

(C)   travel through the vertex

(D)   travel through the centre of curvature

(E)   come to focus at the principal focus

15

S17A
II.3.a
S17C
II.1.a

59

A8

(A)

**

-

***

A light ray strikes a plane mirror with an angle of 30° between its line of direction and the normal at the point of incidence.   The angle of reflection is

(A)   30°

(B)   45°

(C)   60°

(D)   90°

(E)   150°

16

S17A
II.3.a
S17C
II.1.a

59

A8

(B)

**

-

***

The angle between the direction of travel of a light ray and the normal drawn at the point of incidence is 30°.   The angle of reflection is

(A)   15°

(B)   30°

(C)   60°

(D)   90°

(E)   150°

17

S17A
II.3.a
S17C
II.1.a

59

A8
A2

(B)

**

-

**

A ray of light makes an angle of 60° with the surface of a plane mirror.   The angle between the reflected ray and the normal is

(A)   0°

(B)   30°

(C)   45°

(D)   60°

(E)   90°

18

S17A
II.3.a
S17C
III.1.b

60

A1

(A)

***
–
***

When a ray of light travels from air toward glass
at an angle of incidence of zero, most of the light

(A)   travels straight through

(B)   bends away from the normal

(C)   bends towards the normal

(D)   reflects straight back

(E)   reflects at an angle of reflection of 90°

19

S17A
II.3.b
S17C
II.1.b

60

A1
A2

(D)

***
–
***

Where must an object be placed with respect to a
convex (converging) lens in order to obtain a
virtual image?

(A)   at the principal focus

(B)   at twice the focal length

(C)   at a distance greater than twice the focal
      length

(D)   between the principal focus and the lens

(E)   between the principal focus and twice the
      focal length

20

S17A
II.3.b
S17C
II.1.b

60

A1
A2

(E)

***
–
***

The image of a candle produced by a concave
(diverging) lens is always

(A)   virtual, on the same side of the lens as the
      object, and larger

(B)   virtual, on the opposite side of the lens to
      the object, and larger

(C)   virtual, on the opposite side of the lens to
      the object, and smaller

(D)   real, on the same side of the lens as the
      object, and smaller

(E)   virtual, on the same side of the lens as the
      object, and smaller

21

S17A
II.3.c

S17C
II.1.b

60

A1
A2

(E)

***
−
***

Which of the following statements is <u>not</u> correct for
a simple magnifying glass?

(A)   The image is virtual

(B)   The image is erect.

(C)   The image is larger.

(D)   The object is placed inside the focus of the
      lens.

(E)   The lens is concave (diverging).

22

S17A
II.3.b

S17C
II.1.b

60

A1
A2

(B)

***
−
***

Which one of the following characteristics does <u>not</u>
apply to the image formed by a concave (diverging)
lens?

The image is

(A)   virtual

(B)   inverted

(C)   smaller than the object

(D)   located between the lens and its focal point

(E)   located on the same side of the lens as the
      object

23

S17A
II.3.b

60

A1
A2

(A)

***
−
***

Which one of the following statements about images
and diverging (concave) lenses is correct?

(A)   Diverging lenses produce upright, virtual
      images only.

(B)   Diverging lenses produce upright, real images
      only.

(C)   Diverging lenses produce inverted, virtual
      images only.

(D)   Diverging lenses produce inverted, real
      images only.

(E)   Diverging lenses do not produce images.

24

S17A
II.3.b
S17C
II.1.b

60

A1
A2

(A)

An object is placed between the principal focus and the surface of a convex (converging) lens. The image is

(A)   virtual and larger than the object

(B)   real and smaller than the object

(C)   virtual and smaller than the object

(D)   real and larger than the object

(E)   virtual and the same size as the object

***
-
***

25

S17A
II.3.b
S17C
II.1.b

60

A1
A2

(A)

A virtual image can <u>never</u> be

(A)   located using a screen

(B)   located by correcting for parallax

(C)   smaller than the object

(D)   larger than the object

(E)   erect if the object is erect

***
-
***

26

S17A
II.3.b
S17C
II.1.a

60

A1
A2

(D)

An object placed outside the focal point of a convex (converging) lens will produce an image that is

(A)   upright and virtual

(B)   inverted and virtual

(C)   upright and real

(D)   inverted and real

(E)   impossible to locate

***
-
***

27

S17A
II.3.c

60

A1
A2

(B)

***
-
***

The amount of light entering the eye is controlled by the

(A) cornea

(B) iris

(C) lens

(D) retina

(E) optic nerve

28

S17A
II.3.c
S17C
II.1.b

60

A1
A2
A5

(D)

***
-
***

A parallel beam of white light is incident on the surface of a rectangular glass prism at an oblique angle.

How does the prism affect the light?

(A) The prism produces a large complete spectrum.

(B) The prism focuses the beam of white light to a point.

(C) The prism causes the beam of white light to diverge.

(D) The prism does not change the direction of the emergent light but displaces the beam sideways.

(E) The prism changes the direction of the emergent light and displaces the beam sideways.

29

S17A
II.3.a
S17C
II.1.b

60

A1
A8

(E)

**
-
**

A ray of light travelling through air and entering glass at an oblique angle will

(A) speed up only

(B) slow down only

(C) bend toward the normal only

(D) bend away from the normal only

(E) slow down and bend toward the normal

30   A ray of light travels from air toward glass at an
                oblique angle. At the interface, the ray

S17A
II.3.a   (A) is totally reflected
S17C
II.1.a   (B) is bent toward the normal

60   (C) is bent away from the normal

A1   (D) is bent to travel along the normal
A8
                (E) travels straight into the glass without bending
(B)

***
–
***

31   If d_o is the distance of the object from a lens, d_i
                is the distance of the image from the lens, and f
S17A   is the focal length, the height of the image can
II.3.b   be calculated by multiplying the height of the
S17C   object by the ratio
II.1.b
                (A) $\dfrac{d_o}{d_i}$
60

A1
A8   (B) $\dfrac{d_i}{d_o}$

(B)
                (C) $\dfrac{f}{d_o}$
***
–
***   (D) $\dfrac{f}{d_i}$

                (E) $\dfrac{d_o}{f}$

32

S17A
II.3.b
S17C
II.1.b

60

A1
A8

(B)

***
—
***

Where must a point light source be placed with reference to a convex lens to produce a ray of light leaving the lens which is parallel to the principal axis?

(A)   at a distance of two focal lengths from the lens

(B)   at the principal focus of the lens

(C)   between the principal focus and the surface of the lens

(D)   between the principal focus and a distance of two focal lengths from the lens

(E)   as far away as possible from the lens

33

S17A
II.3.b
S17C
II.1.b

60

A1
A8

(C)

***
—
***

When the object is placed at a distance of two focal lengths from the optical centre of a concave (diverging) lens, the image is

(A)   the same size

(B)   inverted

(C)   smaller

(D)   real

(E)   at the centre of curvature

34

S17A
II.3.a
S17C
II.1.b

60

A1
A8

(B)

**
—
**

When a ray of light passes from air into glass at an oblique angle, the light

(A)   bends toward the normal without changing speed

(B)   bends toward the normal and slows down

(C)   bends toward the normal and speeds up

(D)   bends away from the normal and slows down

(E)   bends away from the normal and speeds up

35

S17A
II.3.a
S17C
II.1.b

60

A8
A2

(D)

***
—
***

If a ray of light in air is incident on a plane
glass surface at an angle of 45°, the angle of
refraction will be

(A)   equal to the angle of incidence

(B)   greater than the angle of incidence

(C)   equal to the angle of reflection

(D)   less than the angle of reflection

(E)   independent of the angle of reflection

36

S17A
II.3.c
S17C
II.1.b

S 60

A1
A2

(E)

**
—
**

What is the order of the colours in the spectrum
formed when white light passes through a triangular
prism?

(A)   orange, green, blue, red, violet, yellow

(B)   yellow, green, red, blue, violet, orange

(C)   red, yellow, violet, blue, green, orange

(D)   red, orange, green, blue, yellow, violet

(E)   red, orange, yellow, green, blue, violet

37

S17A
II.3.a
S17C
II.1.b

61

A1
A8

(A)

***
—
***

When a light ray travels at an oblique angle from a
medium with a lower refractive index into a medium
with a higher refractive index, it

(A)   bends towards the normal

(B)   bends to travel along the normal

(C)   bends away from the normal

(D)   doesn't bend at all

(E)   reflects straight back

1   The speed of light in a vacuum is 3×10^{10} m/s.

S17A   (A)   True
II.3.a
S17C   (B)   False
II.1.a

58

A1

(B)

**
-
***

2   Consider the following diagram of a reflecting
               surface.
S17A
II.3.a
S17C
II.1.a

59

F1
A8

(B)

**
-
**   Light travelling along path X and striking the
               reflecting surface will reflect along path Y.

               (A)   True

               (B)   False

3

S17A
II.3.a
S17C
II.1.a

60
59

A10
A3

(B)

***
—
***

.
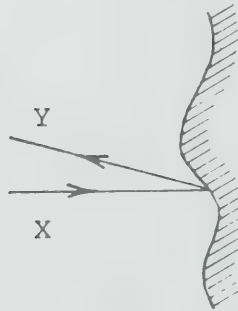
The sparkles and flashes of light seen on the
rippling surface of a sunlit pond are caused by
the refraction of light by the water.

(A)   True

(B)   False

PARTICLE MODEL

OF LIGHT

1

S17C

II.2.f

S 68

A8
A2

(C)

***
-
***

Which one of the following phenomena of light cannot be accounted for by the particle theory?

(A)   pressure

(B)   emission

(C)   interference

(D)   propagation

(E)   reflection

CHARACTERISTICS AND

BEHAVIOURS OF WAVES

1

S17A
II.1.c
S17C
·II.3.b

69

A1
A2

(B)

***
--
***

The speed of a wave in a ripple tank is affected
<u>most</u> by

(A)   the amplitude of the wave

(B)   the depth of the water

(C)   the frequency of the source

(D)   the length of the tank

(E)   the wavelength of the wave

2

S17A
II.1.b
S17C
II.3.a

69

A1
A5

(E)

***
--
***

The direction of propagation of the wavefront of a
transverse wave at any point is

(A)   along the crest of the wave

(B)   along the trough of the wave

(C)   parallel to the wavefront

(D)   at various angles to the wavefront

(E)   perpendicular to the wavefront

3

S17A
II.1.b

69

A2

(E)

***
-
***

The particles of the medium are in periodic motion perpendicular to the direction of propagation of the energy.

Which one of the following terms is defined by the above statement?

(A) longitudinal pulse

(B) longitudinal wave

(C) torsional pulse

(D) transverse pulse

(E) transverse wave

4

S17A
II.1.d
S17C
III.3.a

69

A2

(A)

***
-
***

Two particles vibrating with the same amplitude are in phase if they have the same

(A) displacement and velocity

(B) displacement and speed

(C) displacement only

(D) speed only

(E) velocity only

5

S17A
II.1.b
S17C
III.3.a

69

A2

(E)

*
-
**

The property of the wave which is labelled x in the diagram is called the

(A) amplitude

(B) frequency

(C) velocity

(D) period

(E) wavelength
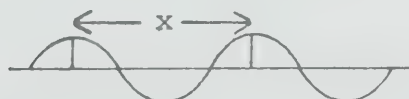
6   A wave train is shown below.

S17A
II.1.b
S17C
II.3.a

69

A2
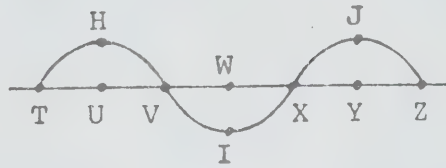
(D)   The wavelength is equal to the length of

**   (A)   the line segments HU + WI
—
***   (B)   the line segment TZ

         (C)   the line segment HU

         (D)   the line segment TX

         (E)   the line segment TV

7   A wave train is shown below.

S17A
II.1.b
S17C
II.3.a

69

A2
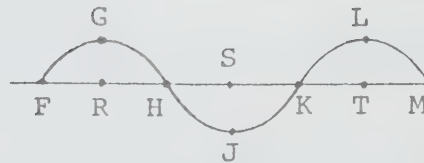
(D)   The wavelength is equal to the length of

***   (A)   the line segment FR
—
***   (B)   the line segment FH

         (C)   the line segment GR

         (D)   the line segment GL

         (E)   the curve FGHJK

8   Consider the following wave diagram:

S17A
II.1.b
S17C
III.3.a

69

A2

(A)

*
_
**

The wavelength of the wave is labelled correctly
by the letter

   (A)   A

   (B)   B

   (C)   C

   (D)   D

   (E)   E
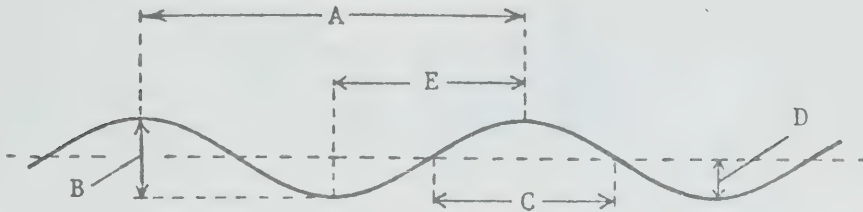
9   Consider the following wave diagram:

S17A
II.1.b
S17C
III.3.a

69

A2

(D)

***
-
***

The amplitude of the wave is labelled correctly
by the letter

   (A)   A

   (B)   B

   (C)   C

   (D)   D

   (E)   E
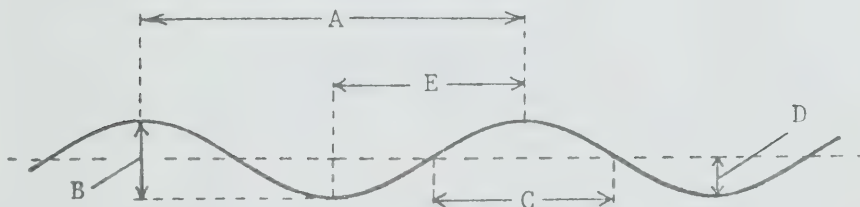
10   A wave train is shown below.

S17A
II.1.b
S17C
III.3.a

69

A2

(E)

**

–

***
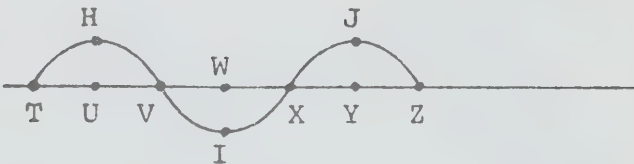
The amplitude of the wave is

(A)   TU

(B)   TV

(C)   TX

(D)   HI

(E)   HU

11   A wave train is shown below.

S17A
II.1.b
S17C
II.3.a

69

A2

(B)

***

–

***
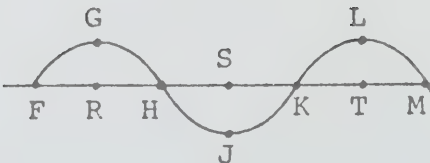
The amplitude is equal to the length of the line

(A)   FR

(B)   RG

(C)   FH

(D)   GL

(E)   GR + SJ

12

S17A
II.1.d
S17C
II.3.a

69

A2

(C)

**

-

**

A transverse wave train is shown below.
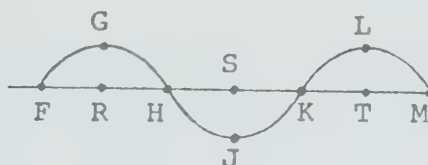
A point in opposite phase to the point H is

(A)   G

(B)   J

(C)   K

(D)   L

(E)   M

13

S17A
II.1.b
S17C
II.3.a

69

A2

(E)

***

-

***

The following diagram shows different points labelled on a wave.
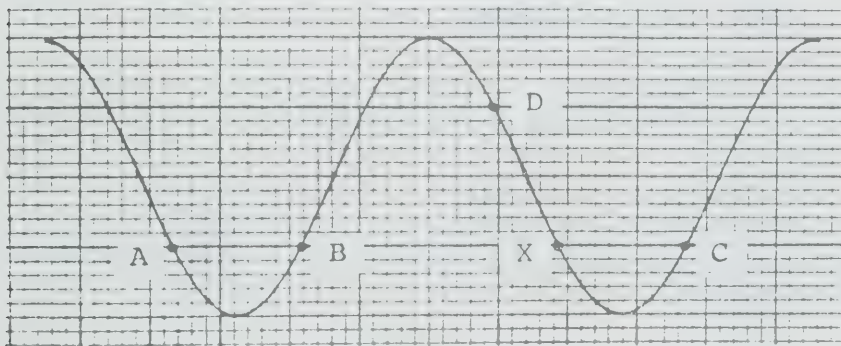
Which one of the labelled points is in opposite phase to point X?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   none of these

14

S17A
II.1.b
S17C
II.3.a

69

A2

(A)

*
—
**

The following diagram shows different points labelled on a wave.
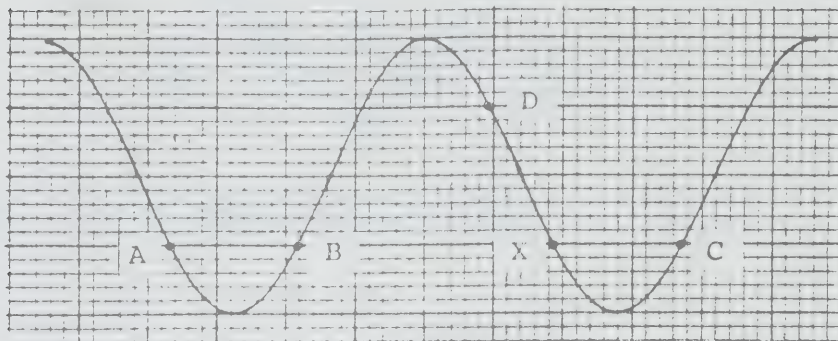
Which one of the labelled points is in the same phase as point X?

(A)   A

(B)   B

(C)   C

(D)   D

(E)   none of these

15

S17A
II.1.b

69

A2

(B)

The particles of the medium are in periodic motion parallel to the direction of propagation of the energy.

Which one of the following terms is defined by the above statement?

(A)   longitudinal pulse

(B)   longitudinal wave

(C)   torsional pulse

(D)   transverse pulse

(E)   transverse wave

16   A transverse wave is travelling through a medium.

S17A
II.1.b
S17C
II.3.a

69

A2
A5

(A)

***
-
***
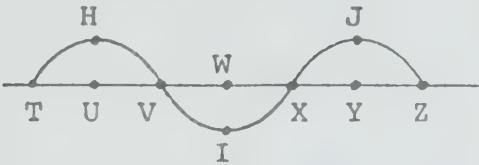
The particles of the medium are moving

(A)   parallel to the line joining HU

(B)   along the line joining TZ

(C)   perpendicular to the line joining HU

(D)   at various angles to the line TZ

(E)   along the curve THVIXJZ

17   Which one of the following properties of a wave is
           independent of all the others?

S17A
II.1.a
S17C
II.3.a

69

A2
A8

(A)

***
-
***

(A)   amplitude

(B)   frequency

(C)   period

(D)   velocity

(E)   wavelength

18

S17A
II.1.b
S17C
II.3.a

69

A6
A2

(D)

***
–
***

The type of wave shown in
the diagram is called a

(A)   longitudinal wave

(B)   sound wave

(C)   standing wave

(D)   transverse wave

(E)   crest wave

19

S17A
II.1.b
S17C
II.3.a

69

B3
A2

(B)

**
–
***

The following diagram shows a transverse wave.
Use a ruler to take any necessary measurements.
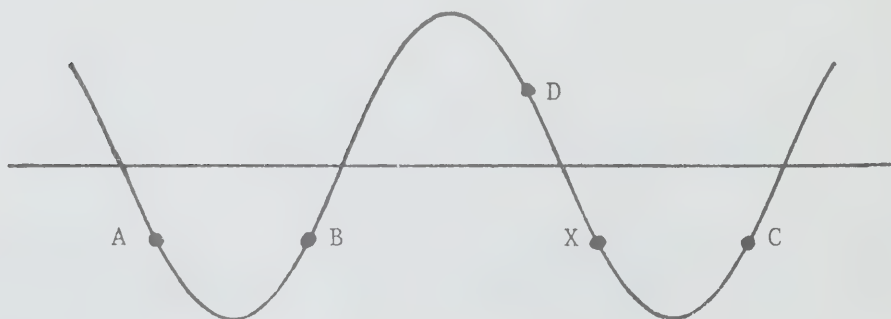
The wavelength of this wave is approximately

(A)   12 cm

(B)   6 cm

(C)   4 cm

(D)   3 cm

(E)   2 cm

20

S17A
II.1.b
S17C
II.3.a

69

B3
A2

(E)

***
-
***

The following diagram shows a transverse wave. Use a ruler to take any necessary measurements.
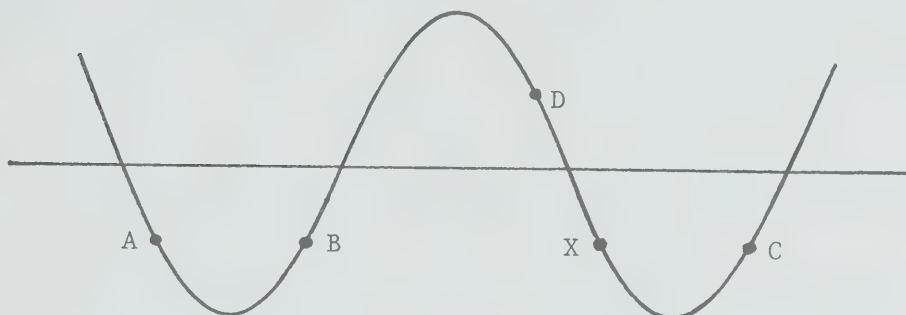
The amplitude of this wave is approximately

(A)   12 cm

(B)   6 cm

(C)   4 cm

(D)   3 cm

(E)   2 cm

21

S17A
II.2.a

69

F1
A2

(B)

***
-
***

A sound wave has a wavelength of 3.0 m. The distance between the centre of a compression and the centre of the adjacent rarefaction is

(A)   0.75 m

(B)   1.5 m

(C)   3.0 m

(D)   6.0 m

(E)   impossible to calculate without knowing the frequency

22

S17A
II.1.a
S17C
II.3.a

69

C3

(B)

***
—
***

The sketches below show different tests you can do with pendulums which are pulled aside and are about to be released.

r   s   t

u   v   w

x   y   z
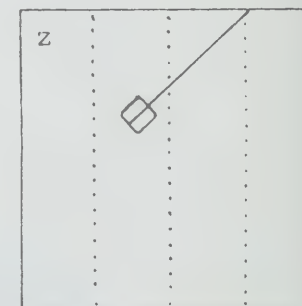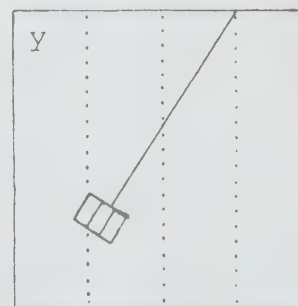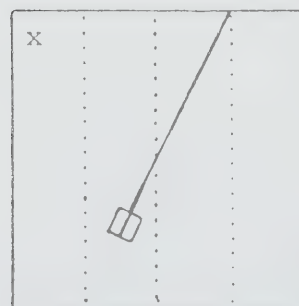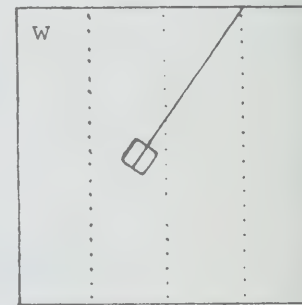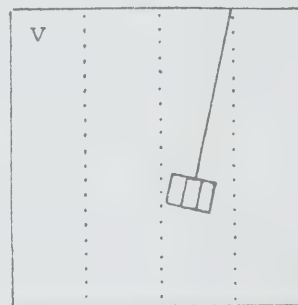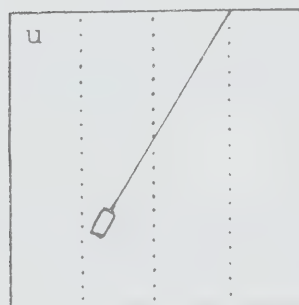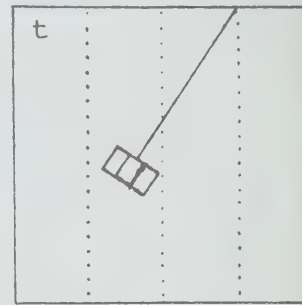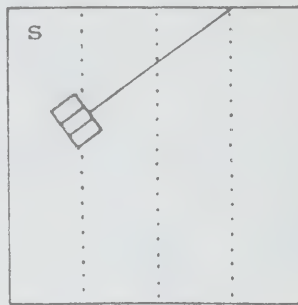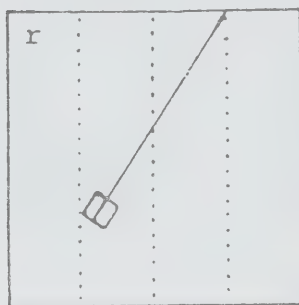
You want to test this idea: the longer the pendulum, the longer its period of vibration. Use a ruler to take any necessary measurements.

Which of the three tests would you use?

(A)   s, t and v

(B)   w, x and z

(C)   r, u and z

(D)   v, x and y

(E)   r, u and y

23

S17A
II.2.a

69

F1
A2

(B)

***
–
***

A sound wave has a wavelength of 3.0 m. The distance between the centre of a compression and the centre of the adjacent rarefaction is

(A)   0.75 m

(B)   1.5 m

(C)   3.0 m

(D)   impossible to calculate without knowing the speed of sound

(E)   impossible to calculate without knowing the frequency

24

S17A
II.1.a
S17C
II.3.a

69

F3
A2

(A)

**
–
**

The frequency of rotation of the second hand on a clock is

(A)   1/60 Hz

(B)   1/12 Hz

(C)   1/2 Hz

(D)   1 Hz

(E)   60 Hz

25

S17A
II.1.b

S 69

A2
A8

(B)

***
–
***

The period of an ideal pendulum with a small swing depends on

(A)   amplitude only

(B)   length of the pendulum only

(C)   mass of the bob only

(D)   amplitude and mass

(E)   amplitude and length of pendulum

26   A pendulum makes 40 vibrations in 20 s.   Its period

S17A   is
II.1.a
                (A)   0.50 Hz

S 69   (B)   0.50 s

F1   (C)   2.0 Hz
A2
                (D)   2.0 s
(B)
                (E)   8.0 x 10^2 Hz
***
-
***

27   A period of 0.005 s yields a frequency of

S17A   (A)   2 x 10^1 Hz
II.1.c
                (B)   5 x 10^1 Hz
70
                (C)   2 x 10^2 Hz
A8
                (D)   5 x 10^2 Hz
(C)
                (E)   2 x 10^3 Hz
***
-
***

28   A tuning fork has a period of vibration of
                2.0 x 10^{-3} s. The speed of sound in air is
S17A   3.0 x 10^2 m/s. The frequency of the sound wave
II.1.c   emitted by the fork is

70   (A)   6.7 x 10^{-6} Hz

A8   (B)   6.0 x 10^{-1} Hz
A2
                (C)   3.0 x 10^2 Hz
(D)
                (D)   5.0 x 10^2 Hz
***
-               (E)   1.5 x 10^5 Hz
***

29   If a wave train has a period of 2.00 s and a wave-
length of 7.00 m, how far will it travel in 8.00 s?

S17A
II.1.c   (A)   2.29 m
S17C
II.3.a   (B)   17.0 m

70   (C)   28.0 m

A8   (D)   56.0 m
A2
           (E)   112 m

(C)

**
--
**

30   A sound of frequency 30.0 Hz, travelling at a
speed of 300 m/s, has a wavelength of

S17A
II.1.c   (A) 9.00×10^3 m
S17C
II.4.b   (B) 3.30×10^2 m

70   (C) 2.70×10^2 m

A8   (D) 1.00×10^1 m
A2
           (E) 1.00×10^{-1} m

(D)

***
--
***

31   A guitar string has a fundamental frequency of
100 Hz. If we change the length so that the string
S17A   is twice as long, but keep everything else the same,
II.1.a   the new frequency of the string will be

70   (A)   25.0 Hz

A8   (B)   50.0 Hz
A5
           (C)   100 Hz

(B)
           (D)   200 Hz
***
--   (E)   400 Hz
***

32   A period of 0.5 s corresponds to a frequency of

S17A
II.1.a   (A)   0.2 Hz
S17C
II.3.a   (B)   0.5 Hz

             (C)   1 Hz

70   (D)   2 Hz

F1
A2   (E)   5 Hz
A8

(D)

***
–
***

33   A wave is sent along a rope with a speed of 8.0 m/s.
           If its frequency is 2.0 Hz, it has a wavelength of

S17A
II.1.c   (A)   0.25 m
S17C
II.4.b   (B)   4.0 m

70   (C)   6.0 m

F1   (D)   10 m
A8

             (E)   16 m
(B)

**
–
***

34   A pendulum vibrates 40 times in 20 s. The frequency
           of the pendulum is

S17A
II.1.a   (A)   0.50 Hz
S17C
II.3.a   (B)   2.0 Hz

70   (C)   20 Hz

F1   (D)   40 Hz
A8

             (E) 8.0×10^2 Hz
(B)

**
–
***

35

S17A
II.1.c
S17C
II.4.b

70

F1
A8

(D)

**

—

***

A sound of frequency 30 Hz, travelling at a speed
of 300 m/s, has a wavelength of

(A) 9.0×10^3 m

(B) 9.0×10^1 m

(C) 1.1×10^1 m

(D) 1.0×10^1 m

(E) 1.0×10^{-1} m

36

S17A
II.1.c
S17C
II.4.b

70

F1
A8

(A)

**

—

**

A wave has a frequency of 20.0 Hz and a wave
length of 3.00 m.   The speed is

(A)   60.0 m/s

(B)   23.0 m/s

(C)   6.67 m/s

(D)   3.33 m/s

(E)   0.150 m/s

37

S17A
II.1.a
S17C
II.3.a

70

F1
A8

(E)

***

—

***

A mass attached to the end of a vertical spring
makes 20 vibrations in 10 s.   Its period is

(A)   20 Hz

(B)   10 s

(C)   2.0 s

(D)   0.50 Hz

(E)   0.50 s

38   In a certain medium, light has a frequency of
            6.0×10^{14} Hz and a wavelength of 3.0×10^{-7} m.
S17A   The speed of light in this medium is
II.1.c
S17C   (A) 5.0×10^6 m/s
II.4.b
            (B) 1.8×10^7 m/s
70
            (C) 1.8×10^8 m/s
F1
A8   (D) 2.0×10^8 m/s

(C)   (E) 3.0×10^8 m/s

***
-
***

39   A pendulum vibrates 40 times in 20 s.   The frequency
            of the pendulum is
S17A
II.1.a   (A)   0.50 Hz
S17C
II.3.a   (B)   0.50 s

70   (C)   2.0 s

F1   (D)   2.0 Hz
A8
A2   (E)   20 Hz

(D)

**
-
**

40   A simple pendulum makes 24 vibrations in 8.0 s.   Its
            frequency is
S17A
II.1.a   (A)   24 Hz
S17C
II.3.a   (B)   3.0 s

70   (C)   3.0 Hz

F1   (D)   0.33 Hz
A8
A2   (E)   0.33 s

(C)

*
-
**

41   A pendulum vibrates 40 times in 20 s.   The period is

S17A   (A) 8.0×10^2 s
II.1.a
S17C   (B)   20 s
II.3.a
           (C)   2.0 s
70
           (D)   0.50 s
F1
A8   (E)   0.025 s
A2

(D)

***
-
***

42   A pendulum has a period of 0.50 s.   Its frequency
           is
S17A
II.1.a   (A)   0.50 Hz
S17C
II.3.a   (B)   2.0 Hz

70   (C)   2.0 s

F1   (D)   5.0 Hz
A8
A2   (E)   10 Hz

(B)

**
-
***

43   If f represents the frequency of a wave, v its speed,
           and T its period, which relationship is correct?
S17A
II.1.b   (A) $f = \frac{1}{T}$
S17C
II.3.a   (B) $f = v + T$

S 70   (C) $f = vT$

A8
           (D) $f = \frac{v}{T}$
(A)

***   (E) $f = \frac{T}{v}$
-
***

44

S17A
II.1.b
S17C
II.4.a

71

A3

(B)

**
–
**

When a wave front meets a smooth polished surface, the direction taken by the reflected wave is determined by the

(A)   material of the surface

(B)   angle of incidence

(C)   nature of the medium

(D)   amplitude of the wave

(E)   wavelength of the wave

45

S17A
II.1.b
S17C
II.4.a

71

F1
A2

(A)

***
–
***

A succession of plane waves approaches a straight barrier. The direction of propagation makes an angle of 60° with the barrier as shown in the diagram.
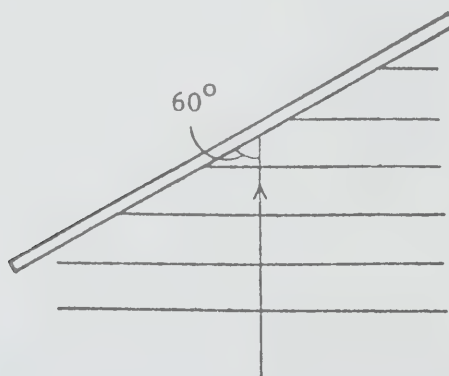
When the waves reflect from the barrier, the "angle of reflection" will be

(A)   30°

(B)   45°

(C)   60°

(D)   90°

(E)   180°

46

S17A
II.1.b

S17C
II.4.c

72

A1

A2

(A)

***
-
***

As water waves pass from deep water to shallow water

(A)   the frequency of the waves remains unchanged

(B)   the speed of the waves increases

(C)   the wavelength increases

(D)   the speed of the waves remains unchanged

(E)   the period of the waves increases

1   Water waves carry amplitude from one place to another.

S17A   (A)   True
II.1.a
             (B)   False
69

A2

(A)

2   Water waves carry compressions from one place to
           another.
S17A
II.1.a   (A)   True

69   (B)   False

A2

(B)

3   Water waves carry energy from one place to another.

S17A   (A)   True
II.1.a
             (B)   False
69

A2

(A)

4   Water waves carry matter from one place to another.

S17A   (A)   True
II.1.a
             (B)   False
69

A2

(B)

5   Water waves carry wavelengths from one place to
another.

S17A

II.1.a   (A)   True

69   (B)   False

A2

(A)

6   The unit for frequency is the hertz.

S17A   (A)   True
II.1.a
S17C   (B)   False
II.3.a

69

A2

(A)

*
_
*

7   The hertz is the unit for period of vibration.

S17A   (A)   True
II.1.a
S17C   (B)   False
II.3.a

69

A2

(B)

***
_
***

8   The number of waves generated per second by a
           source is called the frequency of the source.

S17A
II.1.a   (A)   True
S17C
II.3.a   (B)   False

69

A2

(A)

*
—
**

9   The SI unit for frequency is the hertz.

S17A   (A)   True
II.1.a
S17C   (B)   False
II.3.a

69

A2

(A)

*
—
**

10   The SI unit for period is the hertz.

S17A   (A)   True
II.1.a
S17C   (B)   False
II.3.a

69

A2

(B)

***
—
***

11   Doubling the frequency of a wave source doubles the
                speed of the waves.

S17A
II.1.c   (A)   True
S17C
II.3.a   (B)   False

70

A8

(B)

**
−
**

12   If the frequency of a vibration is 5 Hz, then the
                period of this vibration is 0.2 s.

S17A
II.1.a   (A)   True
S17C
II.3.a   (B)   False

70

F1
A8

(A)

**
−
***

INTERFERENCE OF

PERIODIC WAVES

1

S17A
II.1.d
S17C
II.3.b

75

F1
A8

(B)

**
‑
***

This diagram shows two wave pulses approaching one another:

Which of the following diagrams best represents the appearance of the medium when the centres of the pulses coincide?

(A)

(B)

(C)

(D)

(E)

2   A node is a point where there is always

S17A   (A)   a double crest
II.1.d
S17C   (B)   a double trough
II.5.a
                    (C)   constructive interference
75
                    (D)   destructive interference

A2   (E)   a double rarefaction

(D)

***
-
***

3   Two waves X and Y travel in opposite directions
               in a medium. When interference takes place
S17A   between X and Y
II.1.d
S17C   (A)   the speeds of X and Y change permanently
II.5.a
                    (B)   the shapes of X and Y change permanently
S 75
                    (C)   the frequencies of X and Y change permanently
A2
A5   (D)   the wavelengths of X and Y change permanently

(E)   (E)   no permanent change takes place in X and Y

***
-
***

4   Which of the following is not a condition for the
               production of a standing wave pattern in a string?
S17A
II.1.d   (A)   the same medium
S17C
II.3.b   (B)   two wave trains

76   (C)   identical wavelengths

A1   (D)   opposite direction of travel
A2
               (E)   reflection from one end
(E)

***
-
***

5

S17A
II.1.d
S17C
II.5.a

76

A2
A1

(C)

**
—
***

Which one of the following components is <u>not</u> present in a transverse standing wave pattern?

(A)   an antinode

(B)   a node

(C)   a super compression

(D)   a super crest

(E)   a super trough

6

S17A
II.1.d
S17C
II.5.a

S 76

F1
A2

(E)

***
—
***

Two waves, each of wavelength 5 m, travel in opposite directions in a stretched string 20 m long. Excluding the nodes at the fixed ends of the string, how many nodes appear in the resulting standing wave pattern?

(A)   3

(B)   4

(C)   5

(D)   6

(E)   7

7

S17A
II.1.d
S17C
II.5.a

77

F1
A8
A2

(C)

***
—
***

The distance between two successive nodes on a rope in which standing waves are produced is 30 cm. What is the wavelength of the incident and reflected waves?

(A)   15 cm

(B)   30 cm

(C)   60 cm

(D)   90 cm

(E) 1.2×10^2 cm

8

S17A
II.1.d
S17C
II.5.a

77

F1
A8
A2

(B)

***
-
***

Standing waves that look like those in the sketch
are produced in a coil spring 10 m long. The wave
length of this disturbance is

(A)   2.0 m

(B)   4.0 m

(C)   10 m

(D)   25 m

(E)   50 m

9

17A
II.1.d
S17C
II.5.a

77

F1
A2
A8

(B)

***
-
***

Waves generated at A are reflected at B to produce
a standing wave as shown in the diagram.
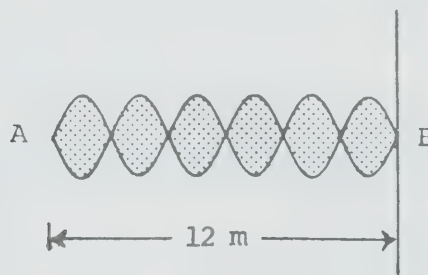
The wavelength of the travelling waves which produce
this standing wave pattern is

(A)   2.0 m

(B)   4.0 m

(C)   6.0 m

(D)   12 m

(E)   36 m

10

S17A
II.1.d
S17C
II.5.a

77

F1
A8
A2

The diagram below illustrates a standing wave produced by two waves travelling in opposite directions on a rope.

|← —————————— 6.0 m —————————— →|
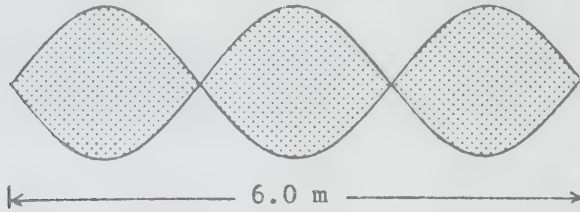
(B)   What is the wavelength of the travelling waves?

***   (A)   6.0 m
-
***   (B)   4.0 m

           (C)   3.0 m

           (D)   2.0 m

           (E)   1.5 m

11

S17A
II.1.d
S17C
II.5.a

S 77

A2
A8

(B)

***
-
***

The distance between successive nodes in a standing wave pattern is

(A)   1/4 λ

(B)   1/2 λ

(C)   3/4 λ

(D)   1 λ

(E)   2 λ

12

S17A
II.1.d
S17C
II.5.a

S 77

F1
A2
A8

(B)

***
−
***

An electric bell with a frequency of 15 Hz produces standing waves of wavelength 40 cm on a stretched string.

What is the distance between adjacent nodes?

(A)   15 cm

(B)   20 cm

(C)   40 cm

(D)   80 cm

(E) 6.0×10^2 cm

13

S17A
II.1.d
S17C
II.5.a

78

A1
A2
A8

(B)

**
−
**

An interference pattern is produced by two point sources vibrating in phase in a ripple tank. If the frequency of the two point sources increases, the pattern

(A)   has fewer nodal lines

(B)   has more nodal lines

(C)   remains the same

(D)   spreads out farther into the ripple tank

(E)   spreads out less into the ripple tank

1

S17A
II.1.d
S17C
II.5.a

77

A1
A2

(A)

**
\-
***

The distance between adjacent nodes in a standing wave is one half the wavelength of the interfering waves.

(A)   True

(B)   False

2

S17A
II.1.d
S17C
II.5.a

78

A2
A1

(A)

**
\-
**

Destructive interference of waves occurs when a crest and trough meet.

(A)   True

(B)   False

3   Destructive interference of waves occurs when two
                   troughs meet.
S17A
II.1.d   (A)   True
S17C
II.5.a   (B)   False

78

A2
A1

(B)

**
_
***

4   Constructive interference of waves occurs when two
                   crests meet.
S17A
II.1.d   (A)   True
S17C
II.5.a   (B)   False

78

A2
A1

(A)

*
_
**

WAVE MODEL OF LIGHT

AND INTERFERENCE

1

S17A
II.3.a
S17C
II.1.b

82

F1
A8

(B)

If the index of refraction for mineral oil is 1.65, and the speed of light in air is 3.00 x 10^8 m/s, then the speed of light in mineral oil must be

(A)   1.35 x 10^8 m/s

(B)   1.82 x 10^8 m/s

(C)   3.00 x 10^8 m/s

(D)   4.65 x 10^8 m/s

(E)   4.95 x 10^8 m/s

***
–
***

2

S17A
II.3.a
S17C
II.6.d

82

F1
A8

(D)

The speed of light in a certain transparent substance is two-fifths of its speed in air. The index of refraction of the substance is

(A)   0.4

(B)   2.0

(C)   2.1

(D)   2.5

(E)   5.0

***
–
***

3

S17A
II.3.a
S17C
II.1.a

82

F1
A11

(A)

***
—
***

A ray of light passes through two different trans-
parent materials (I and II in the diagram) as shown.
The faces of the materials are plane and parallel.

Air

45°

Material I

25°

Material II

40°

Air

45°
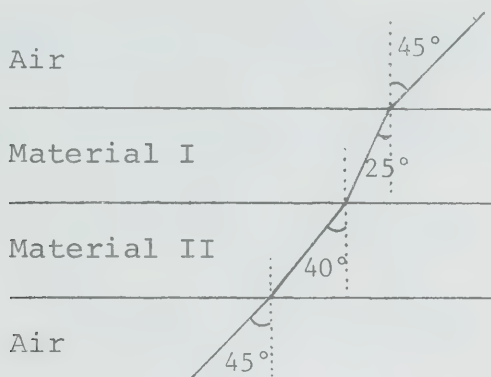
The speed of light in material I is

(A)   less than in air and less than in material II

(B)   greater than in air and less than in material II

(C)   less than in air and greater than in material II

(D)   greater than in air and greater than in
material II

(E)   the same as in air and in material II

4

S17A
II.3.a
S17C
II.1.a

S 82

A1

(B)

***
—
***

How do the speeds of red and blue light in glass
compare to one another and to their speeds in a
vacuum?

(A)   Red light travels faster than blue light and
both travel faster in glass than in a vacuum.

(B)   Red light travels faster than blue light and
both travel slower in glass than in a vacuum.

(C)   Red light travels at the same speed as blue
light and both travel slower in glass than in
a vacuum.

(D)   Red light travels slower than blue light and
both travel faster in glass than in a vacuum.

(E)   Red light travels slower than blue light and
both travel slower in glass than in a vacuum.

5

S17A
II.3.a
S17C
II.6.d

S 82
316

A3

(C)

***
-
***

White light is dispersed into a spectrum by passing
through a triangular glass prism. Since the violet
end of the spectrum is deviated the most, then

(A)   the speed of violet light in glass is greater
      than the speed of red light

(B)   the wavelength of red light in glass is less
      than the wavelength of violet light

(C)   the index of refraction of glass for violet
      light is greater than that for red light

(D)   the index of refraction of glass for red light
      is greater than that for violet light

(E)   the frequency of red light in glass is greater
      than that of violet light

6

S17A
II.3.a
S17C
II.1.b

S 82

A11
A8

(D)

***
-
***

The diagram shows four layers
of transparent liquids on top
of each other. The liquids
do not mix. The path of an
oblique ray of light through
the liquids is shown.

In which liquid is the speed
of the wave the lowest?

(A)   I

(B)   II

(C)   III

(D)   IV

(E)   This cannot be determined on the basis of the
      information given.
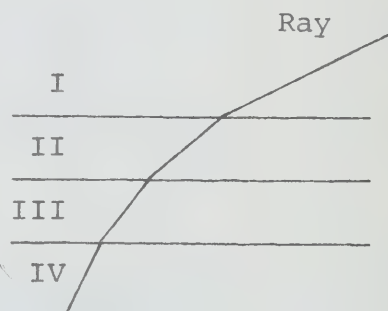
1

S17A
II.3.a
S17C
II.1.b

82

A2
A8

(B)

**

-

**

The diagram represents a ray of light travelling from one transparent material S to another transparent material T.
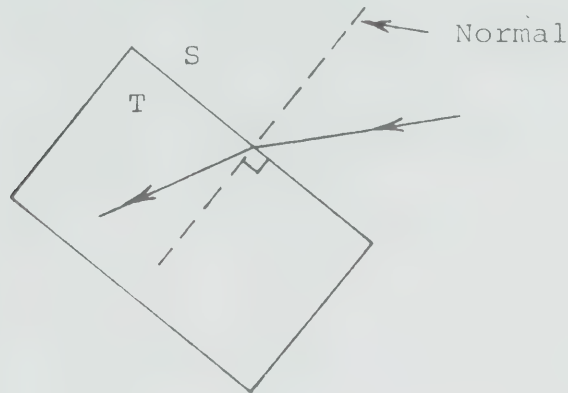
The speed of light in T is greater than its speed in S.

(A)   True

(B)   False

2

S17A
II.3.a
S17C
II.1.b

82

A2
A8

(A)

**

-

**

The diagram represents a ray of light travelling from one transparent material S to another transparent material T.
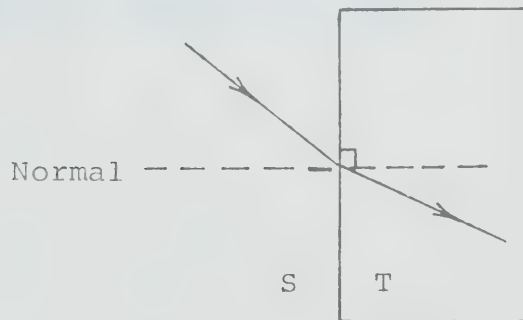
The speed of light in S is greater than its speed in T.

(A)   True

(B)   False

ELECTRICITY

AND

MAGNETISM

ELECTRIC FIELD

AND POTENTIAL

1

S17A
IV.2.b
S17C
IV.1.d

98

F2
A9

(B)

***
–
***

Millikan's oil drop experiment showed that the gravitational force experienced by matter is proportional to the number of electrons in the atoms of that matter.

(A) True

(B) False

ELECTRIC   FORCES

AND   CHARGES

1

S17A

III.1.b

89

A1
A5

(B)

***
-
***

A positively charged object is held near but not touching the knob of an electroscope. The leaves move apart. Without removing the charged object, the knob of the electroscope is then touched with a finger. As a result

(A)   electrons flow from the electroscope to the finger

(B)   electrons flow from the finger to the electroscope

(C)   no electron flow takes place

(D)   the leaves move farther apart

(E)   the leaves remain stationary

2

S17A
III.1.b

89

A1
A5

(B)

**
-
***

An uncharged pith ball is electrically

(A)   attracted by another uncharged pith ball

(B)   attracted by a charged glass rod

(C)   repelled by a charged ebonite rod

(D)   repelled by a charged glass rod

(E)   unaffected by a charged object

3

S17A
III.1.b

When a glass bar rubbed with silk is brought close
to, but not touching, the knob of a negatively
charged electroscope, electrons in the electroscope
move from the

89

A1
A5

(D)

***
-
***

(A)   knob to the glass rod

(B)   glass rod to the knob

(C)   knob to the leaves

(D)   leaves to the knob

(E)   leaves to the glass rod

4

S17A
III.1.b

89

A1
A8

(E)

***
-
***

A glass rod rubbed with silk

(A)   attracts all other electrically charged objects

(B)   repels all other electrically charged objects

(C)   becomes negatively charged

(D)   remains electrically neutral

(E)   becomes positively charged

5

S17A
III.1.b

89

A2

(A)

***
-
***

An electrolyte is

(A)   a solution which conducts electricity by the
      movement of ions

(B)   a material that becomes positive when rubbed
      with another material

(C)   a metal that conducts electricity by the
      movement of electrons

(D)   a metal strip in a voltaic cell

(E)   a type of battery which can be recharged

6

S17A
III.1.c

89

A2

(D)

**

-
***

An object becomes temporarily electrified if a charged object is placed near it. This method of electrification is called

(A)   charging by friction

(B)   charging by contact

(C)   charging by conduction

(D)   charging by induction

(E)   charging by insulation

7

S17A
III.1.c

89

A2

(D)

The free electrons in an insulated conductor can be temporarily redistributed by placing a charged object nearby. This process is called

(A)   conduction

(B)   contact

(C)   friction

(D)   induction

(E)   separation

8

S17A
III.1.a

89

A7

(E)

**

-
***

The electroscope is mainly used to detect

(A)   electric potential

(B)   electric current

(C)   electrical resistance

(D)   moving electric charge

(E)   static electric charge

9   A neutral object

S17A   (A)   has zero electrons
III.1.b
S17C   (B)   has zero protons
IV.1.a
              (C)   is composed only of neutrons
89
              (D)   is electrically attracted to a negative object
A8
              (E)   is electrically attracted to a neutral object
(D)

***
–
***

10   If pith ball X attracts pith ball Y, but repels pith
               ball Z, Y must be
S17A
III.1.b   (A)   positively charged only

89   (B)   negatively charged only

A8   (C)   positively charged or negatively charged, but
                     not neutral
(D)
               (D)   neutral or charged
***
–   (E)   neutral only
***

11   A plastic comb is used to comb a student's hair.
               The comb is then brought near a negatively charged
S17A   metal leaf electroscope. If the leaves of the
III.1.b   electroscope separate further, the comb has

89   (A)   a surplus of electrons

D3   (B)   a surplus of protons

(A)   (C)   a surplus of neutrons

**   (D)   a deficiency of neutrons
–
***   (E)   equal numbers of electrons and protons

12   Consider the following statements:

S17A   I.   A positively charged sphere will repel
III.1.b   a negatively charged sphere.

89   II.   A negatively charged sphere will attract
                             a negatively charged sphere.
A8
                      III.   A positively charged sphere will attract
(C)   a negatively charged sphere.

*   IV.   A positively charged sphere will attract
--   a neutral sphere.
**

                 Which of the above statements are correct?

                 (A)   I and II only

                 (B)   I and IV only

                 (C)   III and IV only

                 (D)   I, II and III only

                 (E)   I, III and IV only

13   How many kinds of electrostatic charges have been
                 found?
S17A
III.1.b   (A)   one
S17C
IV.1.a   (B)   two

S 89   (C)   three

A1   (D)   four

(B)   (E)   five

***
--
***

14

S17A

III.1.b

S 89

A1

(A)

**

\-

**

In a neutral atom the number of electrons is equal to

(A)   the number of protons

(B)   the number of neutrons

(C)   the sum of the number of protons and neutrons

(D)   the difference between the number of protons and neutrons

(E)   the product of the number of protons and neutrons

15

S17A

III.1.b

S 89

A1

(D)

***

\-

***

A neutral metal cylinder is mounted on an insulating stand. One end of the cylinder is labelled X and the other Y. A negatively charged rod is held about 2 cm from end X.

The charge on the cylinder is distributed so that

(A)   end X and end Y are both positive

(B)   end X and end Y are both negative

(C)   end X is negative and end Y is positive

(D)   end Y is negative and end X is positive

(E)   end Y is negative and end X is neutral

16

S17A

III.1.b

S 89

A1

(A)

**

\-

**

To give an uncharged electroscope a negative charge one must

(A)   add electrons

(B)   add protons

(C)   add neutrons

(D)   remove protons

(E)   remove electrons

17   When an ebonite rod is rubbed with fur

S17A   (A)   the rod acquires a positive charge
III.1.b
           (B)   the fur acquires a negative charge
S 89
           (C)   the fur and the rod acquire a positive charge
A1
           (D)   the fur and the rod acquire a negative charge
(E)
           (E)   the fur acquires a positive charge and the rod
**   a negative charge
—
***

18   Which of the following is classified as a good
           insulator?
S17A
III.1.b   (A)   an aluminum wire

S 89   (B)   a copper wire

A1   (C)   graphite

(D)   (D)   hard rubber

**   (E)   any electrolyte
—
**

19   To charge an electroscope negatively by induction
           we need
S17A
III.1.c   (A)   a positively charged object and a ground

S 89   (B)   a negatively charged object and a ground

A1   (C)   two oppositely charged objects only

(A)   (D)   an ebonite rod only

***   (E)   a glass rod only
—
***

20   When an ebonite rod is rubbed with cat's fur

S17A   (A)   the rod becomes positively charged
III.1.b
                (B)   a number of protons leave the rod `
S 89
                (C)   the fur and the rod acquire equal but opposite
A1   charges
A2
                (D)   both the rod and the fur acquire a negative
(C)   charge

***   (E)   both the rod and the fur acquire a positive
-                      charge
***

21   A glass rod is rubbed with wool. What is true about
                each object after the action?
S17A
III.1.b   (A)   The glass rod is positively charged and the
                       wool is positively charged.
S 89
                (B)   The glass rod is negatively charged and the
A1   wool is negatively charged.
A2
                (C)   The glass rod is positively charged and the
(C)   wool is negatively charged.

***   (D)   The glass rod is negatively charged and the
-                      wool is positively charged.
***
                (E)   The glass rod is neutral and the wool is
                       neutral.

22   Which particles within the atom are electrically
                charged?
S17A
III.1.b   (A)   electrons only

S 89   (B)   neutrons only

A1   (C)   protons only
A2
                (D)   electrons and protons
(D)
                (E)   protons and neutrons
**
-
***

23

S17A
III.1.b

S 89

A1
A2

(C)

**

–

**

An ebonite rod is stroked with fur. The charge on the fur is due to a shortage of

(A)   protons

(B)   neutrons

(C)   electrons

(D)   positrons

(E)   ions

24

S17A
III.1.b

S 89

A1
A2

(C)

*

–

**

An uncharged body would acquire a negative charge if it

(A)   gained some atoms

(B)   lost some neutrons

(C)   gained some electrons

(D)   lost some electrons

(E)   gained some protons

25

S17A
III.1.b

S 89

A1
A5

(B)

**

–

***

When ebonite is rubbed with cat's fur

(A)   the ebonite rubs protons off the fur

(B)   the ebonite rubs electrons off the fur

(C)   the fur rubs protons off the ebonite

(D)   the fur rubs electrons off the ebonite

(E)   both the ebonite and the fur become negative

26

S17A
III.1.a

S 89

A1
A5

(B)

***
-
***

An experimenter starts with a neutral electroscope.
An ebonite rod rubbed with cat's fur is brought
near, but <u>not</u> touching, the knob of the electro-
scope. As a result there is

(A)   a positive charge on the leaves

(B)   a negative charge on the leaves

(C)   a negative charge on the knob

(D)   a neutral charge on the leaves

(E)   a neutral charge on the knob

27

S17A
III.1.c

S 89

A1
A5

(E)

**
-
***

When a negative rod is brought close to a neutral
pith ball which is free to move, the pith ball will

(A)   become positively charged by induction

(B)   lose electrons by contact

(C)   not be affected

(D)   be repelled and then attracted by the rod

(E)   be attracted and then repelled by the rod

28

S17A
III.1.b

S 89

A1
A5

(E)

***
-
***

A negatively charged rod is held near, but not
touching, a neutral metal sphere on an insulating
stand. The metal sphere

(A)   is not affected by the charged rod

(B)   becomes positively charged

(C)   becomes negatively charged

(D)   remains neutral, but has an excess of electrons
      on the side nearest the charged rod

(E)   remains neutral, but has an excess of electrons
      on the side farthest from the charged rod

29

S17A
III.1.c

S 89

A1
A5

(A)

***
-
***

The diagram below shows a long neutral conductor supported on an insulating stand. A negatively charged rod is brought near, but not touching, end x.

Which of the following statements describes the resulting charge distribution at x, y and z?

(A)   x positive, y neutral, z negative

(B)   x positive, y positive, z positive

(C)   x positive, y positive, z negative

(D)   x negative, y neutral, z positive

(E)   x neutral, y neutral, z neutral

30

S17A
III.1.b

S 89

A1
A7

(C)

***
-
***

A piece of glass is charged by rubbing it with silk. Which of the following statements is correct?

(A)   The kind of charge on the glass and the silk is the same.

(B)   The silk is uncharged after the rubbing.

(C)   There is an electrical force of attraction between the glass and the silk after rubbing.

(D)   There is an electrical force of repulsion between the glass and the silk after rubbing.

(E)   Positively charged particles are transferred from the silk to the glass during charging.

31

S17A
III.1.c

S 89

A1
A7

(A)

***
–
***

A metal leaf electroscope is charged by induction with a negatively charged rod. Consider the following statements:

   I.   The electroscope becomes charged positively.

  II.   The electroscope becomes charged negatively.

III.   Some electrons move from the electroscope into the ground.

 IV.   Some electrons move from the ground into the electroscope.

  V.   Some protons move from the electro-scope into the ground.

Which two statements are correct?

(A)   I and III

(B)   I and IV

(C)   II and III

(D)   II and IV

(E)   II and V

32

S17A
III.1.b

S 89

A1
A8

(D)

**
–
**

A negatively charged ebonite rod attracts

(A)   a positively charged object only

(B)   a negatively charged object only

(C)   a negatively or a positively charged object

(D)   a neutral or a positively charged object

(E)   a neutral or a negatively charged object

33

S17A
III.1.b

S 89

A1
A8

(E)

***
-
***

When a negatively charged object is brought close to (but not touching) the knob of a neutral electroscope, the leaves will separate because

(A)   both leaves are negative and the knob is neutral

(B)   both leaves are positive and the knob is neutral

(C)   one leaf is positive, the other is negative, and the knob is positive

(D)   both leaves are positive and the knob is negative

(E)   both leaves are negative and the knob is positive

34

S17A
III.1.c

S 89

A1
A8

(A)

***
-
***

When charging an object by induction with a positively charged bar, the object will

(A)   gain electrons from the ground

(B)   lose electrons to the ground

(C)   gain electrons from the bar

(D)   lose electrons to the bar

(E)   gain a deficiency of electrons from the bar

35

S17A
III.1.c

S 89

A1
A8

(B)

***
-
***

A negatively charged rod is brought close to a pith ball. The pith ball moves toward the rod but does not touch it. We can be sure that the pith ball is

(A)   negatively charged only

(B)   not negatively charged

(C)   positively charged only

(D)   neutral only

(E)   neutral or negatively charged

36

The neutral particles contained in the nucleus of an atom are called

S17A
III.1.b   (A)   alpha particles
S17C
IV.5.a   (B)   electrons

S 89   (C)   ions

A2   (D)   neutrons

(D)   (E)   protons

*
-
*

37

An ion is

S17A   (A)   positively charged only
III.1.b
             (B)   negatively charged only
S 89
             (C)   a charged object
A2
             (D)   a charged atom or molecule
(D)
             (E)   an electron only
**
-
***

38

Which of the following particles carries no charge?

S17A   (A)   proton
III.1.a
             (B)   beta particle
S 89
             (C)   ion
A2
A1   (D)   electron

(E)   (E)   neutron

**
-
**

39

S17A
III.1.b

S 89

A2
A5

(B)

**

−

**

Which of the following move when electrification
takes place?

(A)   amperes

(B)   electrons

(C)   neutrons

(D)   ohms

(E)   protons

40

S17A
III.1.b

S 89

A2
A5
A7

(B)

***

−

***

A positive glass rod is brought near, but not
touching, the knob of a neutral metal leaf electro-
scope. With the rod in place, the electroscope is
grounded with a conducting wire. What happens next?

(A)   Electrons flow from the electroscope to the
      ground.

(B)   Electrons flow from the ground to the electro-
      scope.

(C)   Protons flow from the electroscope to the
      ground.

(D)   Protons flow from the ground to the electro-
      scope.

(E)   Electrons move from the metal leaves to the
      knob.

41

S17A
III.1.a

S 89

A2
A7

(C)

**

−

**

To give an uncharged rod a negative charge, one must

(A)   add some atoms

(B)   remove some atoms

(C)   add some electrons

(D)   remove some electrons

(E)   remove some protons

42

S17A
III.1.b

S 89

A2
A8

(B)

***
–
***

A positively charged pith ball, covered with metal foil, is suspended by an insulating thread. A neutral conducting rod on an insulating stand is brought toward the pith ball as shown.
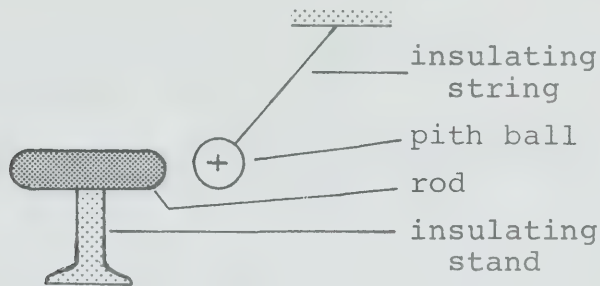
If the pith ball touches the rod

(A)   the rod will become negatively charged

(B)   the rod will become positively charged

(C)   all parts of the rod will remain neutral

(D)   the net charge on the rod will be zero, but the near end will become negative and the far end positive

(E)   the net charge on the rod will be zero, but the near end will become positive and the far end negative

43

S17A
III.1.c

S 89

A7
A1

(B)

***
–
***

Whenever a net charge is placed on an object by induction, the kind of charge on the object

(A)   is the same as the charge on the charging agent

(B)   is opposite to the charge on the charging agent

(C)   depends on whether separation or grounding is used

(D)   depends on the kind of material making up the object

(E)   returns to neutral once the charging agent is removed

44   The following steps are used in charging a neutral
               electroscope by induction.

S17A
III.1.c   I.   The ground wire is removed.

S 89   II.   The electroscope is grounded.

A7   III.   The rod is charged positively.

(D)   IV.   The rod is brought near the
                             electroscope.
***
-                      V.   The rod is removed.
***
               To charge the electroscope negatively, the correct
               order of steps is

               (A)   II, III, IV, V, I

               (B)   II, I, III, IV, V

               (C)   III, II, IV, V, I

               (D)   III, IV, II, I, V

               (E)   III, IV, II, V, I

45   Below are a number of steps used in charging a
               neutral electroscope by induction.

S17A
III.1.c   I.   The ground wire is removed.

S 89   II.   The electroscope is grounded.

A7   III.   The rod is charged negatively.

(B)   IV.   The rod is brought near the
                             electroscope.
***
-                      V.   The rod is removed.
***
               To charge the electroscope positively, the correct
               order of steps is

               (A)   II, III, IV, V, I

               (B)   II, I, III, IV, V

               (C)   III, II, IV, V, I

               (D)   III, IV, II, I, V

               (E)   III, IV, II, V, I

46

S17A
III.1.b

S 89

A7
A1

(C)

***
-
***

A glass rod is rubbed with silk and becomes
positively charged. This means that, after rubbing,

(A)   the glass rod and silk have an excess of
      electrons

(B)   the glass rod and silk have a deficiency of
      electrons

(C)   the glass rod has a deficiency of electrons
      while the silk has an excess of electrons

(D)   the glass rod has an excess of electrons while
      the silk has a deficiency of electrons

(E)   the number of protons gained by the glass rod
      in excess of zero is exactly equal to the
      number of protons lost by the silk

47

S17A
IV.1.b

S 89

E2

(C)

**
-
**

Experiments show that obstacles in the path of
cathode rays produce sharp shadows. The most
reasonable inference from this observation is
that cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   travel at the speed of light

48

S17A
IV.1.b

S 89

E2

(A)

***
-
***

Experiments show that a piece of platinum becomes
red-hot when placed in the path of a narrow beam
of cathode rays. The most reasonable inference
from this observation is that cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   travel at the speed of light

49

S17A
IV.1.b

S 89

E2
A2

(D)

**
-
**

Experiments show that cathode rays are deflected by an electric field. The most reasonable inference from this observation is that cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   travel at the speed of light

50

S17A
III.1.b

S 89

F1
A8

(D)

**
-
***

Four small metal spheres hanging by insulating threads as shown act on each other by electrostatic forces.
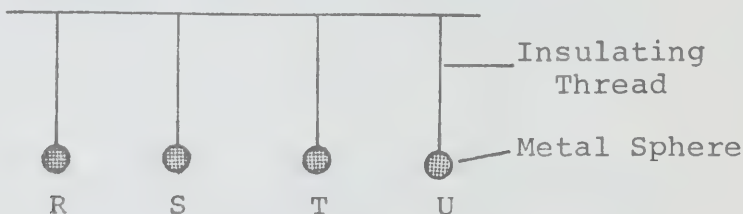
It is known that sphere S is negatively charged. Without permitting the spheres to touch, the following observations are made:

    I.   Sphere S attracts all the other spheres.

    II.   Spheres T and U repel each other.

    III.   Sphere R attracts all the other spheres.

It can be concluded that like charges are carried by

(A)   spheres R and S only

(B)   spheres S and T only

(C)   spheres R, T and U

(D)   spheres T and U only

(E)   spheres S, T and U

51

S17A
III.1.b

S 89

F1
A8

(D)

***
-
***

The leaves of a negatively charged electroscope are observed to diverge more when a charged object is brought near the knob of the electroscope. It is correct to conclude that the object is

(A)   either negatively or positively charged

(B)   an insulator

(C)   a conductor

(D)   negatively charged only

(E)   positively charged only

52

S17A
III.1.b

S 89

I1

(A)

**
-
***

"The leaves of an uncharged metal leaf electroscope diverge when a negatively charged object is brought close to the top of the electroscope."

The above statement is

(A)   an observation

(B)   an inference

(C)   a scientific model

(D)   a scientific law

(E)   a scientific theory

53

S17A
III.1.b
S17C
IV.1.a

90

I1

(D)

**
-
***

"The electric force between any two point charges varies inversely as the square of the distance between them."

The above statement is

(A)   an observation

(B)   a definition

(C)   a scientific model

(D)   a scientific law

(E)   a scientific theory

54

This question involves two statements:

S17A
III.1.b
S17C
IV.1.a

I.   The nucleus of an atom exerts a force
     on an orbiting electron.

II. The orbiting electron exerts no force
     on the nucleus.

90
37

Which of the following responses correctly describes
the two statements?

A8

(A) Both statements are true and one statement can
     be used to explain the other.

(C)

(B) Both statements are true, but neither statement
     can be used to explain the other.

***
–
***

(C) Statement I is true.
     Statement II is false.

(D) Statement I is false.
     Statement II is true.

(E) Statement I is false.
     Statement II is false.

55

The unit of electric charge is the

S17A
III.2.c
S17C
IV.1.a

(A) ampere

(B) coulomb

S 90

(C) ohm

A2

(D) volt

(B)

(E) watt

***
–
***

56   A metal sphere has a deficit of 1.0×10^{10} electrons
                $(1.0 \ C = 6.2 \times 10^{18}$ electrons). What is the charge
S17A   on the sphere?
III.2.c
                (A) 6.2×10^{8} C
S 91
                (B) 1.6×10^{-7} C
F1
A2   (C) -1.6×10^{-7} C

(D)   (D) 1.6×10^{-9} C

***   (E) -1.6×10^{-9} C
-
***

57   A pith ball has an excess of 8.00×10^{4} electrons.
                What is the charge on the pith ball if
S17A $1.00 \ C = 6.24 \times 10^{18}$ electrons?
III.2.c
                (A) 1.28×10^{-14} C
S 91
                (B) -1.28×10^{-14} C
F1
A8   (C) 7.90×10^{13} C

(B)   (D) -7.90×10^{13} C

***   (E) -1.02×10^{23} C
-
***

1

S17A
III.1.a

89

F1
A8

(B)

***
-
***

Object A contains an excess of electrons. Object B
experiences a force of repulsion when brought near
object A, and a force of attraction when brought
near object C.

Object C <u>must</u> have a positive charge.

(A)   True

(B)   False

2

S17C
IV.1.a

90

A8

(A)

**
-
**

The electrical force between two point charges
varies directly as the product of the charges.

(A)   True

(B)   False

3

S17C
IV.1.a

90

A8

(B)

***
-
***

The electrical force between two point charges
varies inversely with the distance between the
charges.

(A)   True

(B)   False

CURRENT ELECTRICITY

AND ELECTROMAGNETISM

1

S17A
III.2.c

S 100

A1

(D)

***
-
***

Sliding across the seat of an automobile can generate several thousand volts of electricity. The driver isn't electrocuted because

(A)   the energy is in the form of electrical potential energy rather than kinetic energy

(B)   the seat is made of material which conducts the charge away from the driver's body

(C)   the driver is insulated from the ground by the rubber tires

(D)   a negligible amount of electrical charge results from the friction

(E)   the electrical resistance of the driver's body limits the electrical current

2

S17A
III.2.a

S 100

A1
A2

(A)

*
-
***

What form of energy from coal is used to generate the electricity in a coal burning generating station?

(A)   chemical energy

(B)   magnetic energy

(C)   mechanical energy

(D)   nuclear energy

(E)   solar energy

3

S17A
III.2.a

S 100

A1
A2

(E)

**

–
**

What form of energy from the fuel is used to generate
the electrical energy at the Pickering Generating
Station?

(A)   chemical energy

(B)   fusion energy

(C)   light energy

(D)   mechanical energy

(E)   nuclear energy

4

S17A
III.2.a

S 100

A1
A2

(E)

**

–
**

Consider the following conditions:

    I.   a complete circuit

    II.   a conductor

    III.   a force to move a charge

Which of the above is/are required before an electric
current will flow?

(A)   I only

(B)   II only

(C)   III only

(D)   I and III only

(E)   I, II and III

5

S17A
III.1.a

S 100

A1
A5

(A)

*

–
*

Which of the following energy transformations take
place in a dry cell?

(A)   chemical to electrical

(B)   chemical to nuclear

(C)   electrical to chemical

(D)   gravitational to electrical

(E)   nuclear to chemical

6

S17A
III.2.a

S 100

A2

(A)

**

–

***

Which one of the following statements correctly describes a voltaic cell?

(A) A voltaic cell is a device for converting chemical energy into electrical energy.

(B) A voltaic cell consists of two metallic plates connected by a conducting wire.

(C) A voltaic cell consists of two identical metal plates immersed in an electrolyte.

(D) A voltaic cell consists of two dissimilar metal plates immersed in distilled water.

(E) A voltaic cell can be recharged by reversing the connections and connecting to a power supply.

7

S17A
1II.2.a

S 100

A2
A1

(C)

**

–

***

An operating voltaic cell may consist of

(A) two similar metal plates and an electrolyte

(B) two similar metal plates and potassium dichromate solution

(C) two dissimilar metal plates and a dilute acid

(D) two dissimilar metal plates and distilled water

(E) two lead sulfate plates and dilute acid

8

S17A
III.2.a

S 100

F1
A2

(B)

***

–

***

A 12 V automobile battery is rated by its manufacturer at 60 A·h. It is capable of delivering

(A) 60 A for 60 h

(B) 3C A for 2.0 h

(C) 12 A for 1.0 h

(D) 12 A for 60 h

(E) 1.0 A for 12 h

9

S17A
III.2.a

S 100

F1
A2

(B)

A 12 V automobile battery is rated by its manu-
facturer at 60 A·h. It is capable of delivering

(A)   60 A for 60 h

(B)   60 A for 1.0 h

(C)   12 A for 1.0 h

(D)   12 A for 60 h

(E)   1.0 A for 12 h

10

S17A
III.2.a

S 100

F1
A2

(B)

A 12 V automobile battery is rated by its manu-
facturer at 60 A·h. It is capable of delivering

(A)   60 A for 60 h

(B)   1.0 A for 60 h

(C)   12 A for 1.0 h

(D)   12 A for 60 h

(C)   1.0 A for 12 h

11

S17A
III.2.c
S17C
IV.2.b

101

A1

(D)

**

-

***

Current is a measure of

(A)   the force that moves a charge past a point

(B)   the resistance to the movement of charge past
      a point

(C)   the energy used to move a charge past a point

(D)   the amount of charge that moves in a certain
      time past a point

(E)   the speed that the charge moves past a point

12   The electric current flowing through a solid metal
            conductor consists of moving

S17A
III.2.c   (A)   atoms
S17C
IV.2.b   (B)   electrons

101   (C)   ions

A1   (D)   neutrons
A2
            (E)   protons
(B)

*
-
*

13   The unit of electrical potential difference is the

S17A   (A)   ampere
III.2.c
S17C   (B)   charge
IV.2.c
            (C)   coulomb
101
            (D)   potential
A2
            (E)   volt
(E)

**
-
***

14   The rate of flow of electric charge is measured in

S17A   (A)   amperes
III.2.a
S17C   (B)   coulombs
IV.2.b
            (C)   kilowatt hours
101
            (D)   volts
A2
            (E)   watts
(A)

***
-
***

15   The unit of electric current is the

S17A   (A)   ampere
III.2.c
S17C   (B)   coulomb
IV.2.b
              (C)   joule per second
101
              (D)   joule per coulomb
A2
              (E)   second per coulomb

(A)

*
—
**

16   The unit of electrical potential difference is the

S17A   (A)   ampere
III.2.c
S17C   (B)   coulomb
IV.2.c
              (C)   kilowatt hour
101
              (D)   ohm
A2
              (E)   volt

(E)

***
—
***

17   One volt is equivalent to

S17A   (A)   1 W·s
III.2.c
S17C   (B)   1 $\frac{J}{s}$
IV.2.c
101
              (C)   1 $\frac{J}{C}$
A4
A2   (D)   1 $\frac{s}{J}$

(C)
              (E)   1 $\frac{C}{J}$
***
—
***

18

S17A
III.2.e
S17C
IV.2.c

101

A4
A8

(B)

**

-

**

Which of the following equations gives the total voltage in a series circuit?

(A) $V_T = V_1 = V_2 = V_3$ . . .

(B) $V_T = V_1 + V_2 + V_3$ . . .

(C) $V_T = \dfrac{I_T}{R_T}$

(D) $V_T = \dfrac{Q}{t}$

(E) $V_T = \dfrac{R_T}{I_T}$

19

S17A
III.2.c
S17C
IV.2.c

101

A8

(C)

***

-

***

A current of 0.80 A flows for 1.0 min. The total electric charge passing a point in this time is

(A) 0.80 C

(B) 1.3 C

(C) 48 C

(D) 75 C

(E) 2.9 x 10^3 C

20

S17A
III.2.c
S17C
IV.2.c

101

B4

(E)

**

-

***

Which one of the following instruments can be used to read directly the potential difference across a resistor in an electrical circuit?

(A) ammeter

(B) galvanometer

(C) ohmmeter

(D) potentiometer

(E) voltmeter

21

S17A
III.2.c
S17C
IV.1.c

101

F1
A8

(B)

**
-
**

Twenty coulombs of charge pass a point in 5.0 s.
The current is

(A)   0.25 A

(B)   4.0 A

(C)   5.0 A

(D)   20 A

(E) 1.0×10^2 A

2 2

S17A
III.2.c
S17C
IV.1.c

101

F1
A8

(C)

***
-
***

Twenty joules of work are done in carrying 2.0 C of
charge from X to Y. The potential difference
between X and Y is

(A)   0.10 V

(B)   2.0 V

(C)   10 V

(D)   20 V

(E)   40 V

2 3

S17A
III.2.c
S17C
IV.2.c

101

F1
A8

(A)

**
-
***

Twelve 1.5 V dry cells connected in parallel will
produce a total voltage of

(A)   1.5 V

(B)   3.0 V

(C)   8.0 V

(D)   9.0 V

(E)   18 V

24

S17A
III.2.c
S17C
IV.2.b

S 101

A2

(B)

*
–
**

An electric current flowing through a metallic wire consists of a flow of

(A)   charged atoms

(B)   negative electrons

(C)   negative ions

(D)   positive ions

(E)   positive protons

25

S17A
III.2.c
S17C
IV.2.c

S 101

A2

(C)

***
–
**

Which one of the following is the correct unit for electrical potential difference?

(A)   A/s

(B)   W/J

(C)   J/C

(D)   C/s

(E)   J/A

26

S17A
III.2.c
S17C
IV.2.b

S 101

A7
A1

(B)

***
–
***

A voltmeter and an ammeter are used to measure the voltage and current respectively in a direct current circuit. How are they connected in the circuit?

(A)   The voltmeter is connected in series and the ammeter in parallel.

(B)   The voltmeter is connected in parallel and the ammeter in series.

(C)   The voltmeter and ammeter are both connected in series.

(D)   The voltmeter and ammeter are both connected in parallel.

(E)   It doesn't matter which way either meter is connected.

27

S17A
III.2.h

S17C
IV.2.c

S 101

A8

(E)

***
—
***

One or more of the following equations is correct
for electrical potential difference V.

I. $V = IR$

II. $V = E/Q$

III. $V = P/I$

Which of the above equations is/are correct?

(A)   I only

(B)   I and II only

(C)   I and III only

(D)   II and III only

(E)   I, II and III

28

S17A
III.2.c

S17C
IV.2.b

S 101

F1
A8

(D)

***
—
***

What is the charge transferred by a current of 0.40 A
flowing for 20 min?

(A) 3.3×10^{-4} C

(B) 1.3×10^{-1} C

(C)   8.0 C

(D) 4.8×10^{2} C

(E) 3.0×10^{3} C

29   What will be the current in a circuit if 12 mC
                        of charge pass a point in one minute?
S17A
III.2.c   (A)   0.20 A
S17C
IV.2.b   (B)   0.20 mA

S 101   (C)   12 mA

F1   (D) 1.2×10^{-2} A
A8
            (E) 7.2×10^{-1} A
(B)

***
-
***

30   If a 4.0 A current flows for 10 s, then the charge
                        transferred is
S17A
III.2.c   (A)   40 A
S17C
IV.2.b   (B)   40 C

S 101   (C)   0.40 C

F1   (D)   2.5 C
A8
            (E)   2.5 electrons
(B)

***
-
***

31   When a current of 3.0 mA is flowing in a circuit,
                        the charge passing a point in the circuit in 10 s is
S17A
III.2.c   (A) 3.0×10^{-3} C
S17C
IV.2.b   (B) 3.0×10^{-2} C

S 101   (C) 3.0×10^{-1} C

F1   (D)   3.0 C
A8
            (E) 3.0×10^{1} C
(B)

***
-
***

32   A current of 0.7 A flows in a circuit for 7 s.
                During that time the charge transferred through
S17A   the circuit is
III.2.c
S17C   (A)   0.1 C
IV.2.b
                (B)   0.5 C
S 101
                (C)   1 C
F1
A8   (D)   5 C

(D)   (E)   8 C

***
—
***

33   A current of 0.70 A continues in a circuit for 7.0 s.
                During that time, the charge transferred through the
S17A   circuit is
III.2.c
                (A)   0.10 C
S 101
                (B)   0.49 C
F1
A8   (C)   3.4 C

(D)   (D)   4.9 C

**   (E)   10 C
—
***

34   The copper conductor having the least resistance
                would be
S17A
III.2.f   (A)   thin, long and hot

102   (B)   thick, short and cool

A1   (C)   thick, long and hot

(B)   (D)   thin, short and cool

***   (E)   thin, short and hot
—
***

35

S17A
III.2.f

102

F1
A2
A5

(C)

***
-
***

Which of the following graphs best represents the voltage-current relationship for an incandescent light bulb?

(A) V

(B) V

(C) V

(D) V

(E) V
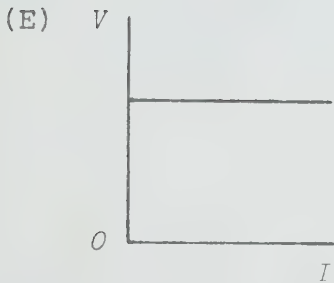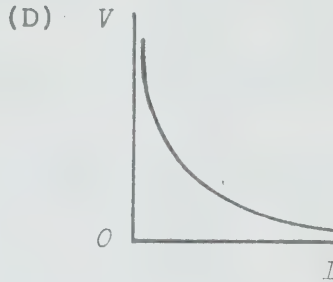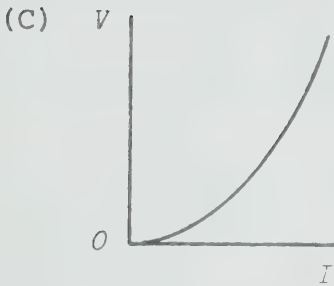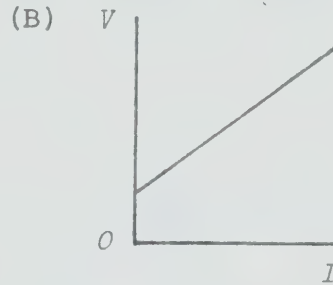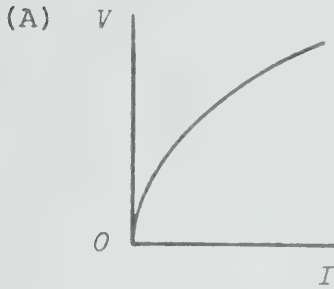
36

S17A
III.2.f

S 102

A1
A8

(B)

***
-
***

The electrical resistance of an ohmic conductor is affected by

(A) current only

(B) temperature only

(C) voltage only

(D) current and voltage only

(E) current, temperature and voltage

37

S17A
III.2.f

Which of the following graphs best represents the current-voltage relationship of an incandescent light bulb?

102

F1
A2
A5

(A)

***
—
***

(A) I

(B) I

(C) I

(D) I

(E) I

38

S17A
III.2.e

S 102

A2

(B)

**
—
***
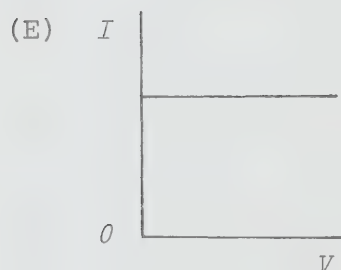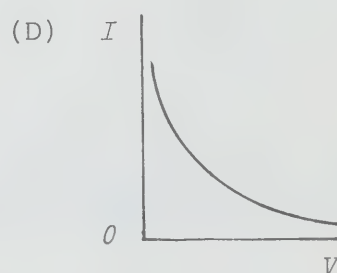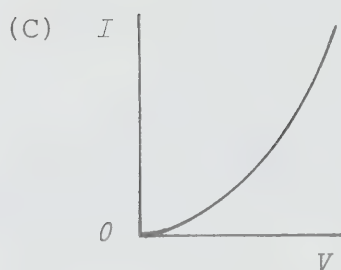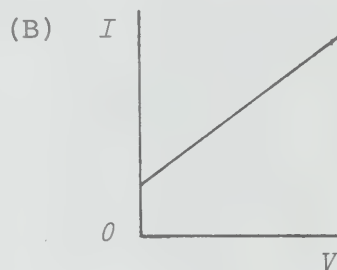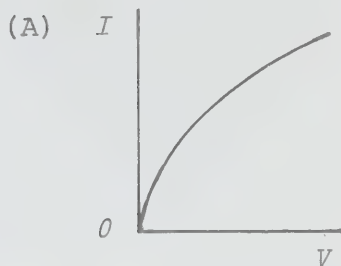
Potential difference divided by current is called

(A)   voltage

(B)   resistance

(C)   energy

(D)   power

(E)   conductance

39

S17A
III.2.h

102

F1
A8

(A)

***

-

***

The circuit shown
contains a dry cell
and an ohmic
conductor.

20 Ω   1.5 V
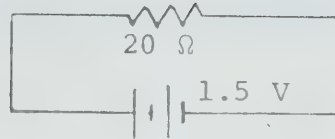
Which one of the
following statements
is correct regarding
the circuit?

(A)   If the voltage of the battery doubles, the
       resistance of the resistor remains unchanged.

(B)   The current flowing in the circuit is constant
       regardless of the voltage applied.

(C)   The power dissipated by the resistor is constant
       regardless of the voltage applied.

(D)   The addition of a similar resistor in series
       leaves the power dissipated by the resistor
       unchanged.

(E)   If the resistance is reduced to half the original
       value, the voltage output of the battery auto-
       matically doubles.

40

S17A
III.2.e

S 102

A1
A8

(B)

***

-

***

Which one of the following statements about the
resistance of a metallic conductor is not correct?

(A)   The resistance of a conductor varies directly
       with its length.

(B)   The resistance of a conductor varies directly
       with its cross-sectional area.

(C)   The resistance of a conductor depends on the
       material making up the conductor.

(D)   The resistance of a conductor increases as the
       temperature increases.

(E)   The resistance of a conductor becomes very
       small at temperatures near -273°C.

41   Which of the following statements is correct for a
              fuse in an electrical circuit?

S17A
III.2.h   (A)   A fuse is connected in parallel in a circuit.

S 102   (B)   A fuse has a large resistance.

A2   (C)   A fuse limits the voltage in a circuit.
A1
              (D)   A fuse limits the current in a circuit.
(D)
              (E)   A fuse limits the energy used in a circuit.
**
-
***

42   This question involves two statements:

S17A   I.   In order to measure the potential
III.2.c   difference across a resistor, the
                         voltmeter must be connected in
S 102   parallel with the resistor.

A7   II. To measure the current through a
                         resistor, the ammeter must be
(B)   connected in series with the
                         resistor.
**
-             Which of the following responses correctly describes
***   the two statements?

              (A)   Both statements are true and one statement can
                    be used to explain the other.

              (B)   Both statements are true, but neither statement
                    can be used to explain the other.

              (C)   Statement I is true.
                    Statement II is false.

              (D)   Statement I is false.
                    Statement II is true.

              (E)   Statement I is false.
                    Statement II is false.

43

S17A
III.2.e

S 102

A11

(D)

***
-
***

Which of the following graphs best illustrates the relationship between resistance R of a wire and its length l ?

(A)

(B)

(C)

(D)

(E)
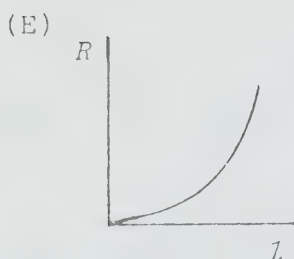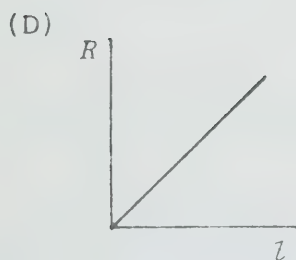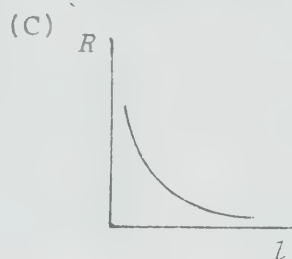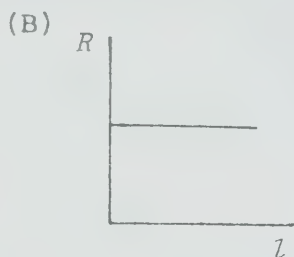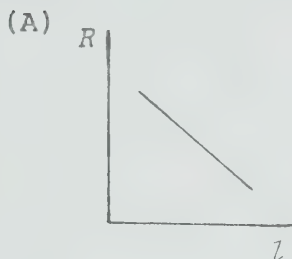
44

S17A
III.2.g

S 102

F1
A8

(C)

***
-
***

What potential difference must exist between the ends of a wire which has a resistance of 20 Ω, so that 40 C of charge pass through it in 10 s?

(A)   5.0 V

(B)   20 V

(C)   80 V

(D) 8.0×10^2 V

(E) 8.0×10^3 V

45   The unit of electrical resistance is the

S17A   (A)   ampere
III.2.e
              (B)   coulomb
103
              (C)   ohm
A2
              (D)   volt
(C)
              (E)   watt
**
-
**

46   Which one of the following graphs shows the correct
              relationship between the resistance of a wire and
S17A   its cross-sectional area?
III.2.e

S 103   (A)   (B)   (C)

A11

(D)

***
-
***

              (D)   (E)

47

S17A

III.2.f

S 103

A1

A2

(A)

**

-

***
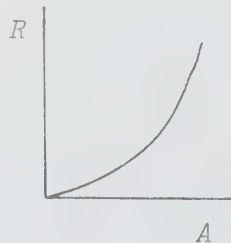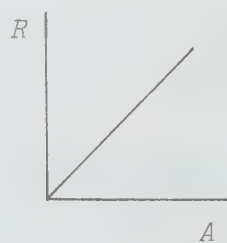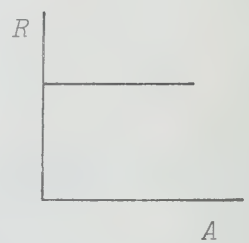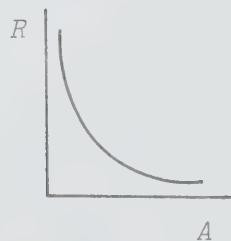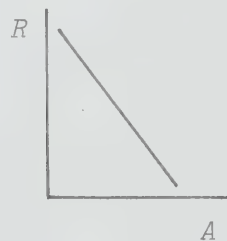
Since copper is a better conductor of electricity than iron, we can infer that copper

(A) contains a greater proportion of mobile electrons

(B) is a better conductor of heat

(C) cannot be magnetized as easily

(D) has a higher density

(E) contains fewer free protons

48

S17A

III.2.f

S 103

F1

A1

(E)

**

-

***

A charged electroscope will retain nearly all of its charge if touched by a

(A) wet hand

(B) water pipe

(C) long copper wire

(D) steel retort stand

(E) dry glass beaker

49

S17A

III.2.f

S 103

F1

A8

(B)

***

-

***

A copper wire 1.0×10^{-6} m^2 in cross-sectional area is to have a resistance of 3.2 Ω. If the resistivity of copper is 1.6×10^{-8} $\Omega \cdot m^2/m$, the length of the wire should be

(A) 2.0 m

(B) 2.0×10^2 m

(C) less than 2.0 m

(D) 20.0 m

(E) 2.0×10^3 m

50

S17A
III.2.g

104

A2
A7

(B)

***

—

***

This question involves two statements:

    I.   Alternating current is supplied to
        most households in Ontario.

   II.   The appliances of a household circuit
        are connected in parallel.

Which of the following responses correctly describes
the two statements?

(A)   Both statements are true and one statement can
      be used to explain the other.

(B)   Both statements are true, but neither statement
      can be used to explain the other.

(C)   Statement I is true.
      Statement II is false.

(D)   Statement I is false.
      Statement II is true.

(E)   Statement I is false.
      Statement II is false.

51

S17A
III.2.g

104

A2
A8

(A)

**

—

**

An ammeter is connected correctly into a series
circuit in two different ways. First it is
connected between the positive terminal of the
battery and a resistor and a current reading of I_1
is recorded. Then the ammeter is connected between
the negative terminal of the battery and the resistor
and a current reading of I_2 is recorded. How will
the two readings compare?

(A) $I_1 = I_2$

(B) I_1 and I_2 are not zero, but I_1 is larger than I_2.

(C) I_1 and I_2 are not zero, but I_2 is larger than I_1.

(D) $I_1 = 0$, but I_2 is larger than zero.

(E) $I_2 = 0$, but I_1 is larger than zero.

52

S17A
III.2.g

104

A2
A11

(D)

*
—
**

In which one of the following circuits are the
dry cells connected in parallel and the bulbs
connected in series?

(A)

(B)

(C)

(D)

(E)

53

S17A
III.2.f

104

A1
A8

(C)

**
—
***
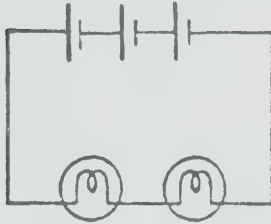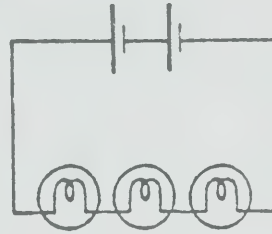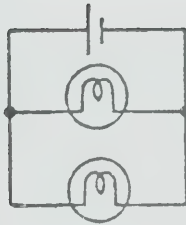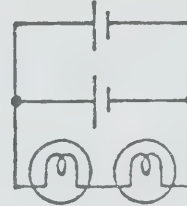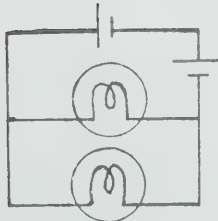
If the voltage applied to a circuit is doubled and
the resistance halved, the current will be

(A) doubled

(B) halved

(C) quadrupled

(D) quartered

(E) unchanged

54   Consider the three circuits shown below:

S17A
III.2.g

104

A7

(E)

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–
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I.   II.   III.
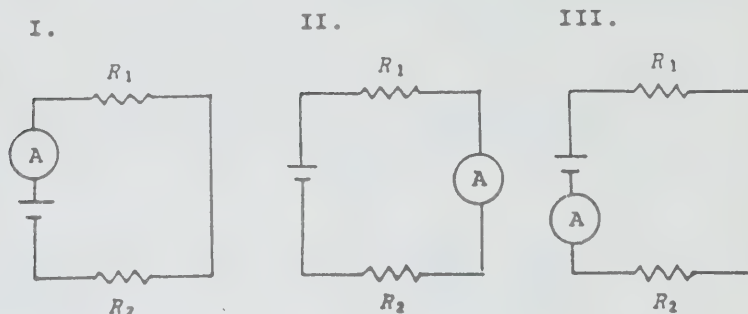
In which of these circuits is the ammeter connected
correctly to measure the current through the two
resistors?

(A)   I only

(B)   II only

(C)   III only

(D)   I and III only

(E)   I, II and III

55   What is the effect when a second identical resistor
is added in series in a circuit containing one
S17A   resistor and a dry cell?
III.2.g

104   (A)   The resistance of the circuit decreases.

F1
A2   (B)   The resistance of the circuit increases.
A8
               (C)   The current through the original resistor
(B)   stays the same.

**   (D)   The voltage drop across the original resistor
–   stays the same
**
               (E)   The voltage drop across the original resistor
                     increases.

56

S17A
III.2.g

104

F1
A8

(D)

**
-
***

A current of 0.50 A flows through a potential difference of 100 V. What is the resistance of the circuit in ohms?

(A) 5.0×10^{-3}

(B) 2.5×10^{1}

(C) 5.0×10^{1}

(D) 2.0×10^{2}

(E) 4.0×10^{2}

57

S17A
III.2.g

104

F1
A8

(E)

**
-
***

If a 7.0 V battery produces a current of 14 A, what is the resistance in the circuit?

(A)   98 Ω

(B)   21 Ω

(C)   7.0 Ω

(D)   2.0 Ω

(E)   0.50 Ω

58

S17A
III.2.g

104

F1
A8

(C)

***
-
***

If two 8.0 Ω resistors are connected in parallel in a circuit, their total resistance will be

(A)   0.13 Ω

(B)   0.25 Ω

(C)   4.0 Ω

(D)   16 Ω

(E)   64 Ω

59

S17A
III.2.g

104

F1
A8

(D)

**

‒

***

A resistance of 2.0 Ω connected across the terminals
of a 12 V battery will result in a current of

(A)   48 A

(B)   24 A

(C)   14 A

(D)   6.0 A

(E)   0.17 A

60

S17A
III.2.g

104

F1
A8

(D)

***

‒

***

A 12 Ω resistor is connected in parallel with a
6.0 Ω resistor.   The total resistance is

(A)   18 Ω

(B)   12 Ω

(C)   6.0 Ω

(D)   4.0 Ω

(E)   0.25 Ω

61

S17A
III.2.g

104

F1
A8

(C)

***

‒

***

Four 20 Ω resistors are connected in parallel. If
the resulting combination is connected to a 20 V
battery, the current flowing from the battery will be

(A)   0.25 A

(B)   1.0 A

(C)   4.0 A

(D)   5.0 A

(E) 1.0×10^2 A

62

S17A
III.2.g

104

F1
A8

(D)

***
-
***

Resistances of 2.0 Ω, 4.0 Ω, and 6.0 Ω are
connected in series with a 24 V battery. The
current flowing through the 2.0 Ω resistor is

(A)   12 A

(B)   4.0 A

(C)   2.4 A

(D)   2.0 A

(E)   0.50 A

63

S17A
III.2.e

104

F1
A8

(C)

***
-
***

In order to double the current in a circuit in which
the voltage has been doubled, the resistance must be

(A)   made one quarter as large

(B)   made one half as large

(C)   kept the same

(D)   made twice as large

(E)   made four times as large

64

S17A
III.2.e

104

F1
A8

(A)

**
-
***

If the resistance of an electrical circuit were
halved and the voltage applied to the circuit
doubled, the current in the circuit would

(A)   be four times as large

(B)   be twice as large

(C)   remain the same

(D)   be half as large

(E)   be one quarter as large

65

S17A
III.2.e

104

F1
A8

(B)

**

–

**

The resistance in an electrical circuit is tripled. In order to keep the current the same, the voltage applied to the circuit must be

(A)   made nine times as large

(B)   made three times as large

(C)   kept the same

(D)   made one third as large

(E)   made one ninth as large

66

S17A
III.2.g

104

F1
A8

(D)

*

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**

A total resistance of 3.0 Ω is to be produced by connecting an unknown resistance in parallel with a 12 Ω resistance. What must be the value of the unknown resistance?

(A)   1.0 Ω

(B)   2.0 Ω

(C)   3.0 Ω

(D)   4.0 Ω

(E)   6.0 Ω

67

S17A
III.2.g

104

F1
A8

(C)

A total resistance of 3.0 Ω is to be produced by connecting an unknown resistance to a 12 Ω resistance.

What must be the value of the unknown resistance and how should it be connected?

(A)   3.0 Ω in parallel

(B)   3.0 Ω in series

(C)   4.0 Ω in parallel

(D)   4.0 Ω in series

(E)   6.0 Ω in parallel

68

S17A
III.2.g

104

F1
A8

(B)

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***

If resistances of 2.0 Ω and 4.0 Ω are connected in parallel to a 12 V supply, the current leaving the supply is

(A)   16 A

(B)   9.0 A

(C)   6.0 A

(D)   3.0 A

(E)   2.0 A

69

S17A
III.2.g

104

F1
A8

(B)

**
—
**

An electric heater operating on a 100 V supply has a resistance of 20 Ω. The current in the heater is

(A)   0.20 A

(B)   5.0 A

(C) 8.0×10^1 A

(D) 1.2×10^2 A

(E) 2.0×10^3 A

70

S17A
III.2.f

104

F1
A8

(E)

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***

Resistors of 10 Ω and 30 Ω are connected in series to a 120 V supply. The current in the 30 Ω resistor is

(A)   16 A

(B)   12 A

(C)   8.0 A

(D)   4.0 A

(E)   3.0 A

71

S17A
III.2.g

104

F1
A8

(D)

**

-

***

Two loads have resistances of 2.0 Ω and 4.0 Ω
respectively. When the loads are connected in
series with a 12 V source, the current in the
circuit is

(A)   9.0 A

(B)   6.0 A

(C)   3.0 A

(D)   2.0 A

(E)   0.50 A

72

S17A
III.2.g

104

F1
A8

(C)

**

-

***

Two loads have resistances of 2.0 Ω and 4.0 Ω
respectively. When the loads are connected in
series with a 12 V source, the current in the
circuit is

(A)   6.0 A

(B)   3.0 A

(C)   2.0 A

(D)   1.5 A

(E)   0.50 A

73

S17A
III.2.g

104

F1
A8

(C)

***

-

***

What is the effective resistance when a 50 Ω
resistance, a 25 Ω resistance, and a 10 Ω resistance
are connected in parallel?

(A)   0.16 Ω

(B)   0.63 Ω

(C)   6.3 Ω

(D)   8.5 Ω

(E)   85 Ω

74

S17A
III.2.g

104

F1
A8

(A)

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-
***

A simple circuit containing two resistors connected to a battery is shown below.
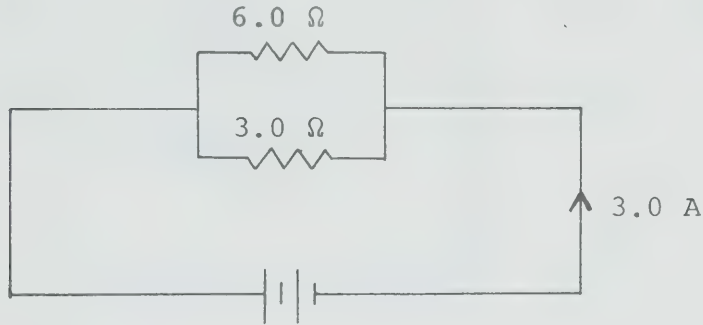
The current passing through the 6.0 Ω resistor is

(A)   1.0 A

(B)   1.1 A

(C)   1.5 A

(D)   2.0 A

(E)   3.0 A

75

S17A
III.2.g

104

F1
A8

(B)

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-
***

A galvanometer can be converted to a voltmeter by adding a high resistance in series with the galvanometer. If a certain galvanometer has a full-scale deflection with a current of 20.0 mA and a resistance of 100 Ω, the resistance that must be added to convert it to a voltmeter capable of measuring up to 1000 volts is

(A) 5.00×10^4 Ω

(B) 4.99×10^4 Ω

(C) 5.00×10^3 Ω

(D) 9.98×10^2 Ω

(E) 5.00×10^2 Ω

76

S17A
III.2.g

104

F1
A8

(A)

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***

A simple circuit containing two resistors connected to a battery is shown below.

6.0 Ω

3.0 Ω

2.0 A
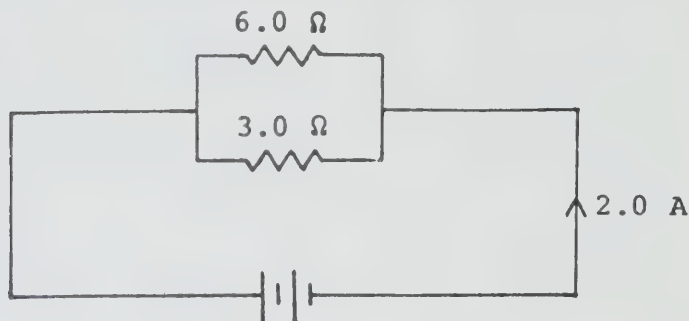
The current passing through the 6.0 Ω resistor is

(A)   0.67 A

(B)   0.75 A

(C)   1.0 A

(D)   1.3 A

(E)   2.0 A

77

S17A
III.2.g

104

F1
A8

(A)

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***

If each of the resistors in the following diagrams has a resistance of 4.0 Ω, which combination has the lowest resistance?

(A)

(B)

(C)

(D)

(E)
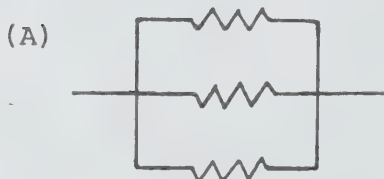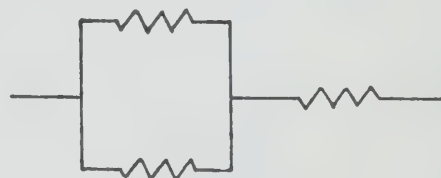
78

S17A
III.2.g

104

F1
A8

(B)

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In the diagram below, resistance R_1 is greater than R_2.
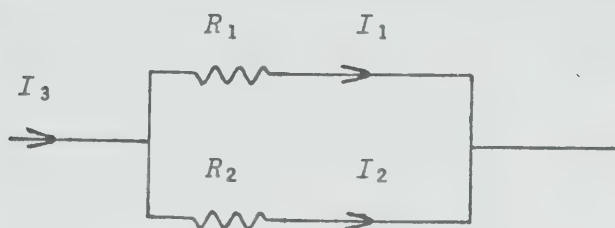
Which one of the following statements about the currents I_1, I_2, and I_3 is true?

(A) I_1 is greater than I_2

(B) $I_1 + I_2 = I_3$

(C) $I_1 - I_2 = I_3$

(D) $I_2 - I_1 = I_3$

(E) $I_1 = I_2 = I_3$

79

S17A
III.2.g

104

F1
A8

(D)

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***

A circuit contains a battery and two resistors as shown.
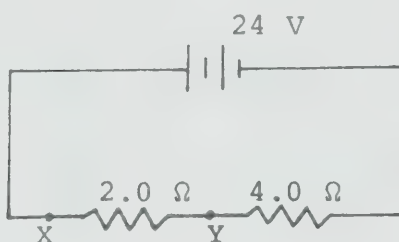
The potential difference between X and Y is

(A)   24 V

(B)   16 V

(C)   12 V

(D)   8.0 V

(E)   2.0 V

80

A circuit contains one battery and two resistors as shown.

$$6.0 \text{ V} \quad R_1 = 1.0 \ \Omega \quad R_2 = 2.0 \ \Omega$$
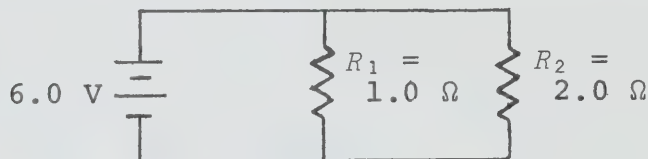
(B)   The current through R_2 is

**
-
***

(A)   0.33 A

(B)   3.0 A

(C)   6.0 A

(D)   9.0 A

(E)   12 A

81

A circuit contains one battery and two resistors as shown.

$$6 \text{ V} \quad R_1 = 1 \ \Omega \quad R_2 = 2 \ \Omega$$

The current drawn from the battery is

(E)

***
-
***

(A)   2 A

(B)   3 A

(C)   4 A

(D)   6 A

(E)   9 A

82

S17A
III.2.g

104

F1
A8

(C)

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***

The following circuit contains a battery, three resistors, and two ammeters connected as shown. All three resistors are different.
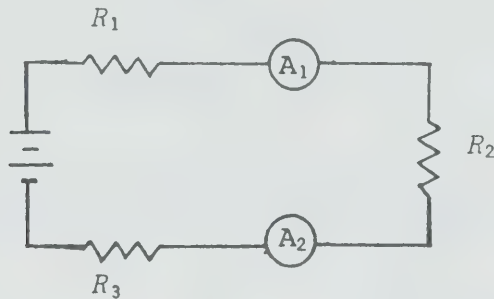
If ammeter A_1 reads a current of 10 mA, what can be said about the current in ammeter A_2?

(A)   The current in ammeter A_2 is more than 10 mA.

(B)   The current in ammeter A_2 is less than 10 mA.

(C)   The current in ammeter A_2 is exactly 10 mA.

(D)   The current is ammeter A_2 cannot be determined without knowing the values of R_2 and R_3.

(E)   The current in ammeter A_2 cannot be determined without knowing the values of R_1, R_2, and R_3.

83

S17A
III.2.g

104

F1
A8

(E)

***
-
***

A circuit contains a battery and two resistors as shown.

The potential difference across R_2 is

(A)   1 V

(B)   2 V

(C)   3 V

(D)   4 V

(E)   6 V

84

S17A
III.2.g

104

F1
A8

(D)

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-
***

Two identical resistors are connected across a
supply voltage V, as shown below.
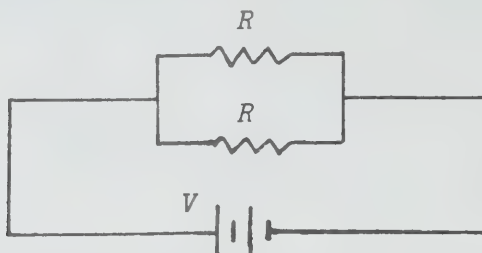
The current flowing through each resistor is equal
to

(A) $V/4R$

(B) $V/2R$

(C) $2V/R$

(D) V/R

(E) R/V

85

S17A
III.2.g

104

F1
A8

(A)

**
-
***

A circuit contains two resistors connected to a
battery as shown. The current leaving the battery
is 0.5 A.
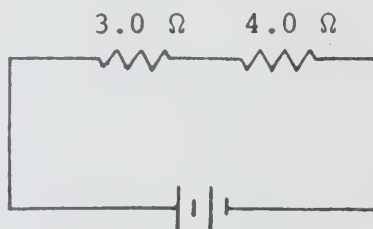
What is the voltage drop across the 3.0 Ω resistor?

(A)   1.5 V

(B)   3.0 V

(C)   3.5 V

(D)   6.0 V

(E)   7.0 V

86

S17A
III.2.g

104

F1
A8

(A)

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The diagram below shows a circuit containing a
battery, a switch, three ammeters, and two resistors.
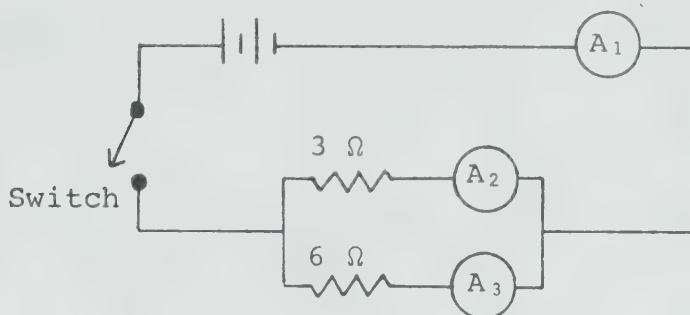
When the switch is closed, the voltage reading across
the 6 Ω resistor is

(A)   the same as the reading across the 3 Ω resistor

(B)   twice the reading across the 3 Ω resistor

(C)   half the reading across the 3 Ω resistor

(D)   twice the reading across the battery

(E)   half the reading across the battery

87

S17A
III.2.g

104

F1
A8

(B)

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**

A circuit containing a battery and two resistors is
shown.
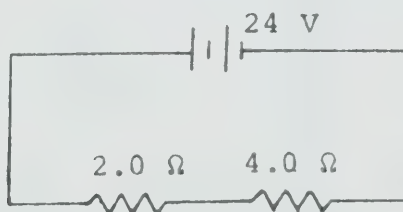
The effective resistance of the circuit is

(A)   24 Ω

(B)   6.0 Ω

(C)   2.0 Ω

(D)   1.3 Ω

(E)   0.75 Ω

88

S17A
III.2.g

104

F1
A8

(E)

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The diagram below shows a circuit containing a battery, a switch, three ammeters, a voltmeter, and two resistors.
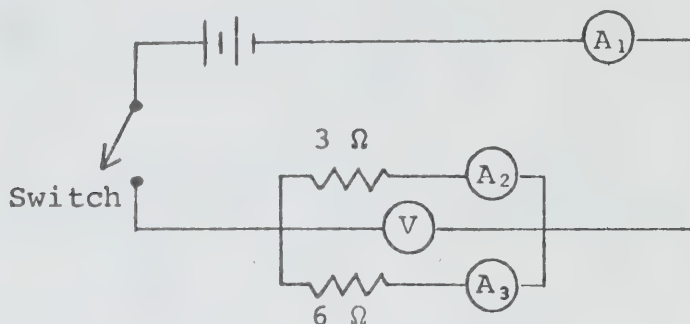
When the switch is closed, the current through ammeter A_1 is

(A)   equal to the current through ammeter A_2

(B)   equal to the current through ammeter A_3

(C)   equal to the difference of the currents through ammeters A_2 and A_3

(D)   equal to the sum of the currents through ammeters A_2 and A_3

(E)   equal to the sum of the currents through ammeters A_2 and A_3 and voltmeter V

89

S17A
III.2.g

104

F1
A8

(C)

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A circuit containing a battery and two resistors is shown below.
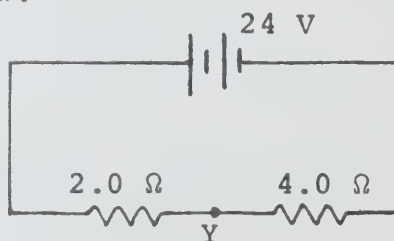
The current at Y is

(A)   2.0 A

(B)   2.7 A

(C)   4.0 A

(D)   6.0 A

(E) 1.4×10^2 A

90

S17A
III.2.g

104

F1
A8

(B)

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The diagram below shows a circuit containing a
battery, a switch, three ammeters, a voltmeter,
and two resistors.
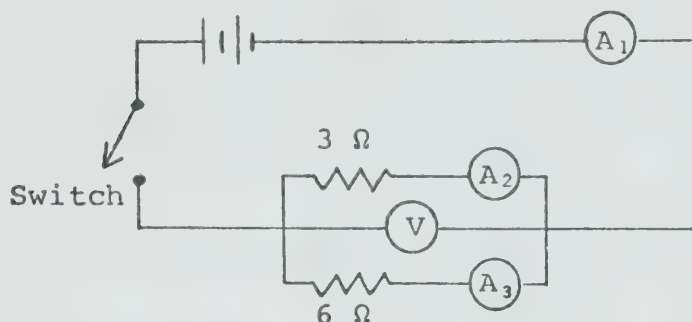
When the switch is closed, the current through
ammeter A_2 is

(A)   equal to the current through ammeter A_3

(B)   twice the current through ammeter A_3

(C)   half the current through ammeter A_3

(D)   equal to the current through voltmeter V

(E)   smaller than the current through voltmeter V

91

S17A
III.2.g

104

F1
A8

(E)

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A circuit contains a battery and two resistors as
shown.
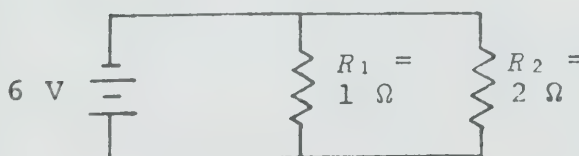
The effective resistance of the circuit is

(A)   1 Ω

(B)   2 Ω

(C)   3 Ω

(D)   3/2 Ω

(E)   2/3 Ω

92

A circuit containing five resistors connected to a 12 V battery is shown below.
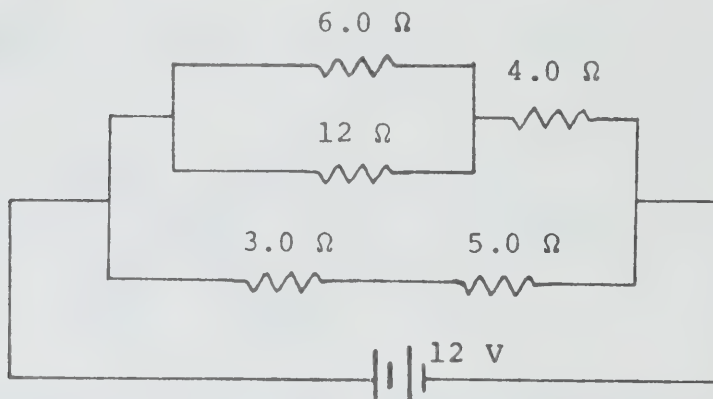
What is the current going through the 5.0 Ω resistor?

(A)   0.42 A

(B)   0.67 A

(C)   1.5 A

(D)   2.4 A

(E)   3.0 A

93

A circuit containing several resistors is shown below.
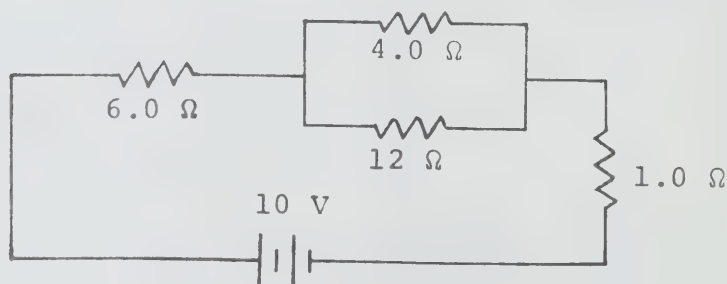
How much current flows through the 4.0 Ω resistor?

(A)   3.2 A

(B)   2.5 A

(C)   1.0 A

(D)   0.75 A

(E)   0.25 A

94   A circuit containing five resistors connected to a
         12 V battery is shown below.

S17A
III.2.g

104

F1
A8

(B)

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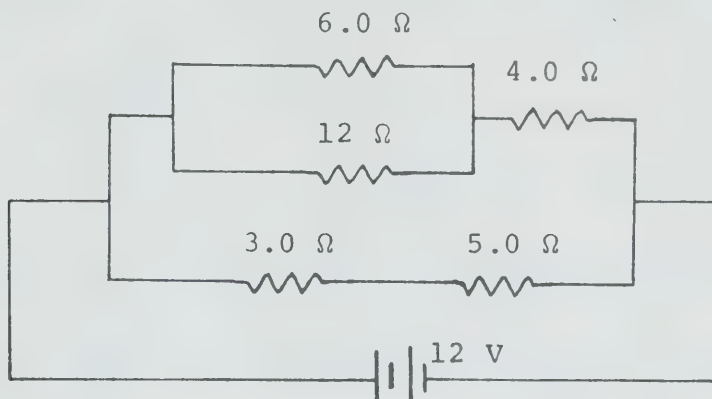
What is the voltage drop across the 5.0 Ω resistor?

(A)   6.0 V

(B)   7.5 V

(C)   8.0 V

(D)   9.0 V

(E)   12 V

95   A circuit containing several resistors is shown below.

S17A
III.2.g

104

F1
A8

(A)

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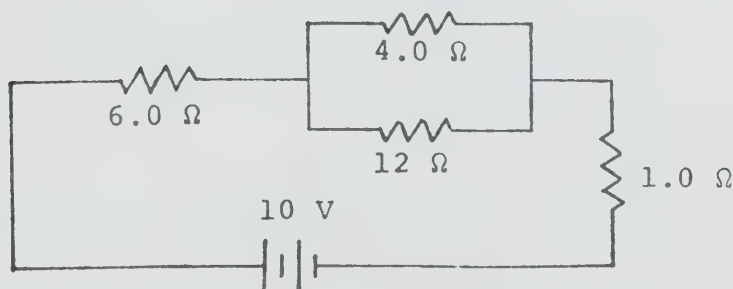
The voltage drop across the 6.0 Ω resistor is

(A)   6.0 V

(B)   4.2 V

(C)   3.0 V

(D)   2.6 V

(E)   0.75 V

96

S17A
III.2.g

104

F1
A8

(C)

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A circuit contains two resistors connected to a battery as shown. The current leaving the battery is 0.50 A.

3.0 Ω   4.0 Ω
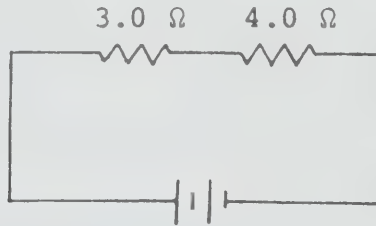
What is the voltage of the battery?

(A)   1.5 V

(B)   3.0 V

(C)   3.5 V

(D)   6.0 V

(E)   7.0 V

97

S17A
III.2.g

104

F1
A8

(B)

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A simple circuit containing two resistors connected to a battery is shown below.

6.0 Ω

3.0 Ω

2.0 A
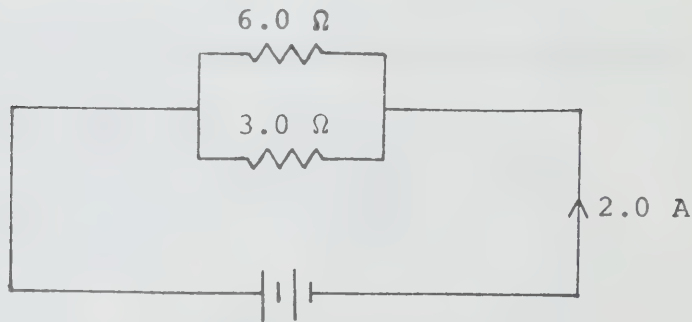
What is the voltage of the battery?

(A)   1.0 V

(B)   4.0 V

(C)   6.0 V

(D)   12 V

(E)   18 V

98

S17A
III.2.g

104

F1
A8

(E)

The diagram shows a circuit consisting of a battery, two resistors and a switch.

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When the switch is closed, the voltage drop across the 3 Ω resistor is

(A)   the same as the voltage drop across the 6 Ω resistor

(B)   slightly larger than the voltage drop across the 6 Ω resistor

(C)   slightly smaller than the voltage drop across the 6 Ω resistor

(D)   twice the voltage drop across the 6 Ω resistor

(E)   half the voltage drop across the 6 Ω resistor

99

S17A
III.2.g

104

F1
A8

(B)

A circuit containing several resistors is shown below.

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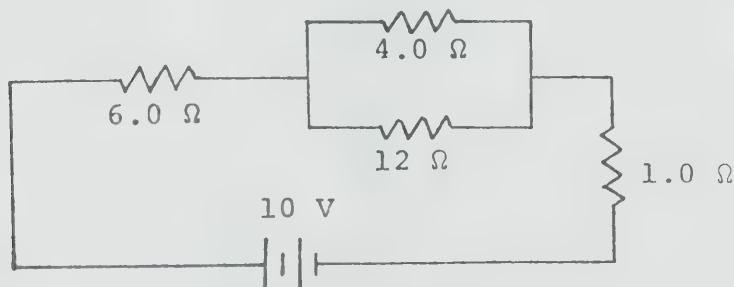
The total current passing through this circuit is

(A)   8.0 A

(B)   1.0 A

(C)   0.70 A

(D)   0.50 A

(E)   0.43 A

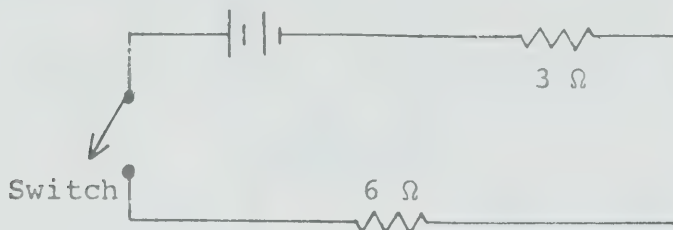**100**   The diagram shows a circuit consisting of a battery,
              two resistors and a switch.

S17A
III.2.g

104

F1
A8

(A)

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-
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When the switch is closed, the potential difference
across the battery is

(A)   equal to the sum of the potential differences
      across the two resistors

(B)   equal to the difference between the potential
      differences across the two resistors

(C)   equal to the potential difference across the
      3 Ω resistor

(D)   equal to the potential difference across the
      6 Ω resistor

(E)   not related to the potential difference across
      the two resistors

101

S17A
III.2.g

104

F1
A8

(A)

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The diagram shows a circuit consisting of a battery,
two resistors and a switch.

When the switch is closed, the current flowing
through the 3 Ω resistor is

(A)   the same as the current through the 6 Ω
      resistor

(B)   slightly larger than the current through the
      6 Ω resistor

(C)   slightly smaller than the current through the
      6 Ω resistor

(D)   twice the current through the 6 Ω resistor

(E)   half the current through the 6 Ω resistor

102

S17A
III.2.g

104

F1
A8

(D)

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A circuit containing several resistors is shown below.
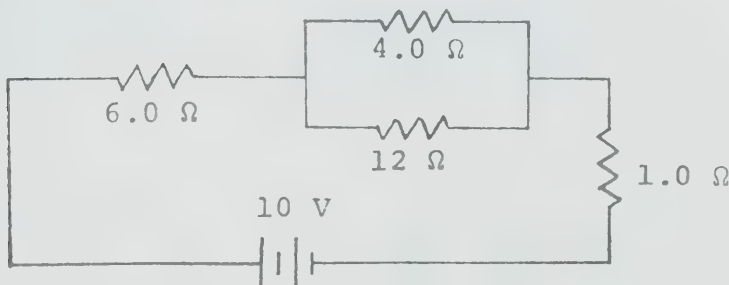
The total resistance of this circuit is

(A)   23 Ω

(B)   20 Ω

(C)   14 Ω

(D)   10 Ω

(E)   1.5 Ω

103   Circuit X contains one dry cell and one bulb as
             shown below.

S17A
III.2.g

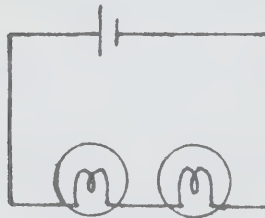104
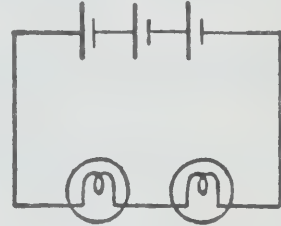
F1

(D)

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             In which one of the following circuits will the
             bulbs glow with the same brightness as the bulb
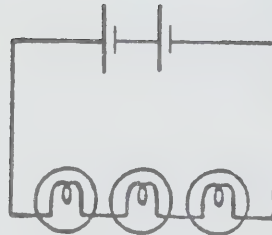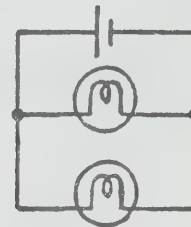   in circuit X?   Assume that all bulbs are identical.
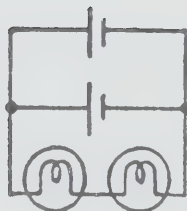
104

S17A
III.2.g

104

F1
All

(B)

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Assume that all bulbs shown in the following circuits
are identical.   In which one of the circuits would
the effective external resistance be the greatest?
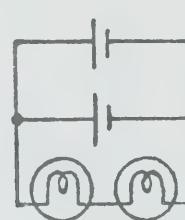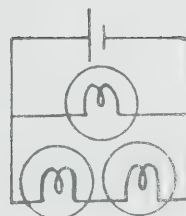
(A)

(B)

(C)

(D)

(E)

105

S17A
III.2.g

104

F1
All

(D)

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-
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Assume that all bulbs shown in the following circuits
are identical. In which one of the circuits would
the effective external resistance be the least?

(A)

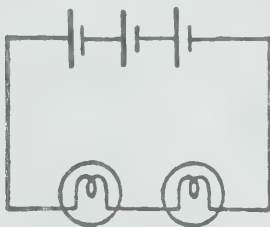(B)

(C)
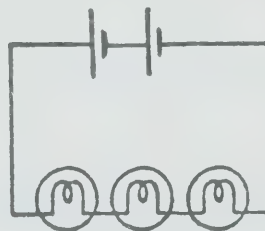
(D)

(E)

106

S17A
III.2.g

104

F1
A11

(D)

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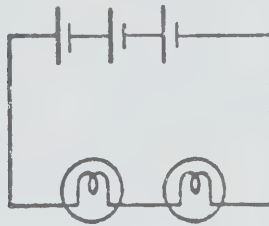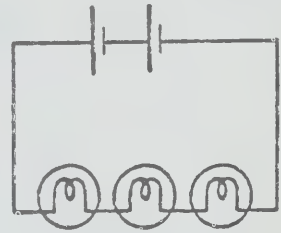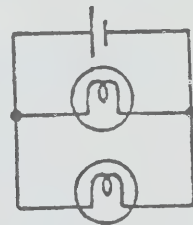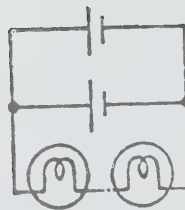
In which one of the following circuits will the bulbs glow for the longest time if each bulb is rated at 1.5 V, and each cell is 1.5 V?
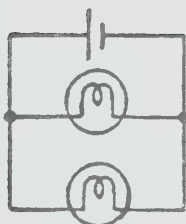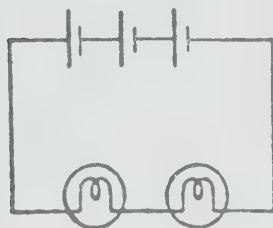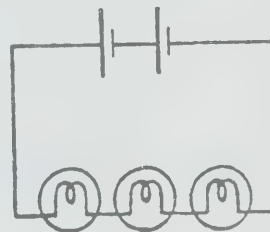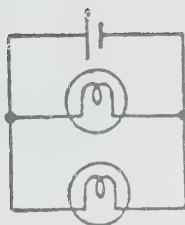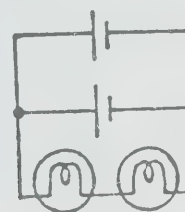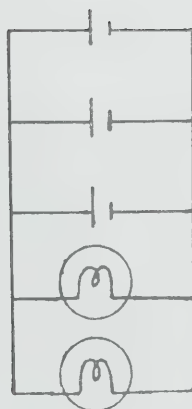
(A)

(B)

(C)

(D)

(E)

107

S17A
III.2.g

Assume that all bulbs shown in the following circuits
are identical. In which one of the circuits will the
bulbs be the dimmest?

104

F1
All

(D)

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-
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(A)
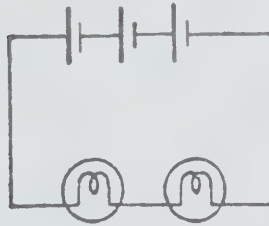
(B)
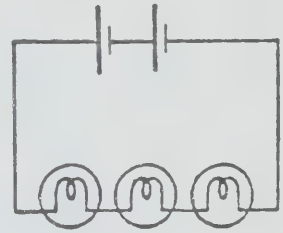
(C)

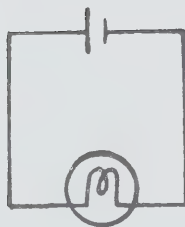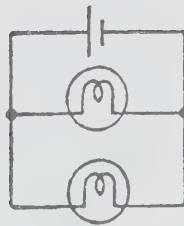(D)
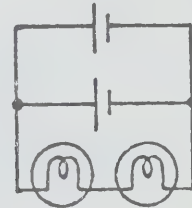
(E)
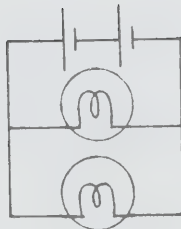
108   A circuit containing five resistors connected to a
           12 V battery is shown below.

S17A
III.2.g

104

F1
A8

(A)

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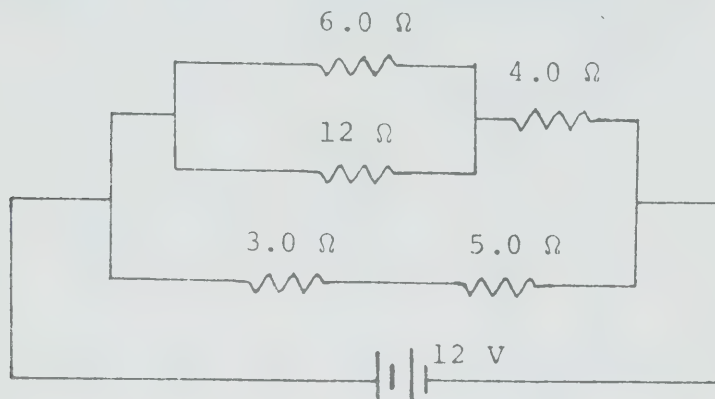
What is the total effective resistance of the
circuit?

(A)   4.0 Ω

(B)   10 Ω

(C)   12 Ω

(D)   16 Ω

(E)   30 Ω

109   A circuit contains a battery connected to a resistor.
           An experimenter wishes to take measurements using a
S17A   voltmeter and an ammeter in order to calculate the
III.2.e   resistance of the resistor. How should they be
           connected into the circuit?
S 104

           (A)   Connect the voltmeter in series and the ammeter
A7   in parallel with the resistor.

(B)   (B)   Connect the voltmeter in parallel and the
                  ammeter in series with the resistor.
***
-          (C)   Connect both the voltmeter and ammeter in series
***   with the resistor.

           (D)   Connect both the voltmeter and ammeter in
                  parallel with the resistor.

           (E)   Connect the voltmeter and ammeter in parallel
                  with one another. Then connect the combination
                  in series with the resistor.

110

S17A
III.2.e

S 104

A7
A11

(B)

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Five circuits containing a battery and a load R
are shown below. Some circuits contain both an
ammeter and a voltmeter. Others contain only one
of the two instruments. Which circuit shows the
instrument(s) connected correctly?

(A)
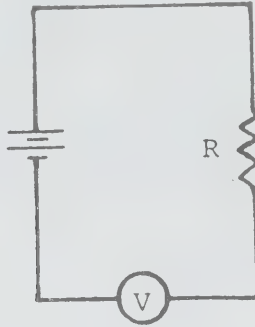
(B)
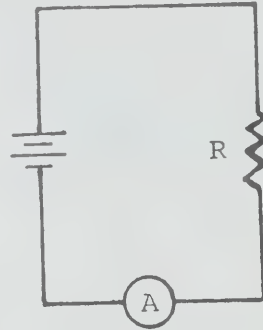
(C)
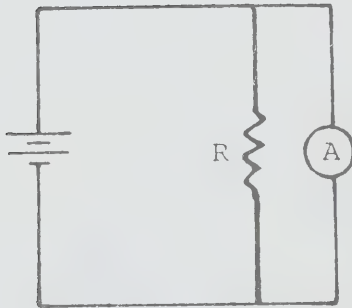
(D)
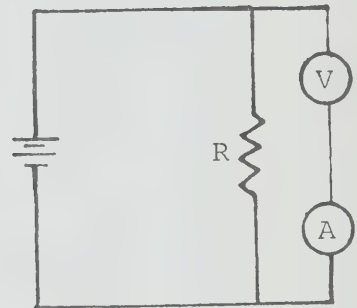
(E)
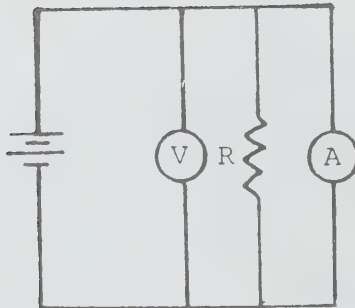
111

S17A
III.2.e

S 104

A7
A11

(D)

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-
***

Five circuits containing a battery and a load R
are shown below. Some circuits contain both an
ammeter and a voltmeter. Others contain only one
of the two instruments. Which circuit shows the
instrument(s) connected correctly?

(A)
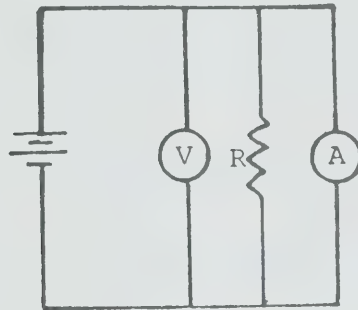
(B)

(C)

(D)

(E)

112

S17A
III.2.e

S 104

A7
A11

(A)

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–
***

Five circuits containing a battery and a load R
are shown below. Some circuits contain both an
ammeter and a voltmeter. Others contain only one
of the two instruments. Which circuit shows the
instrument(s) connected correctly?

(A)

(B)

(C)

(D)

(E)

113

S17A
III.2.g

S 104

A11
A1

(D)

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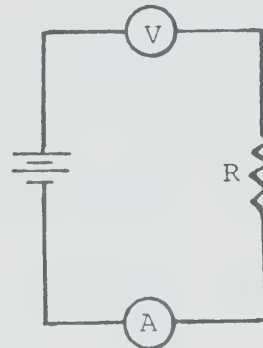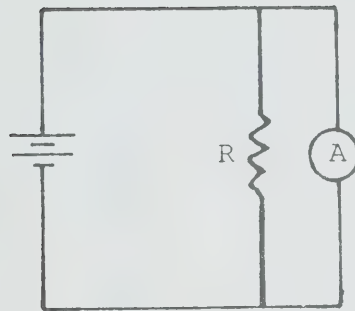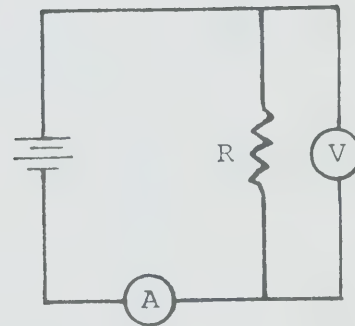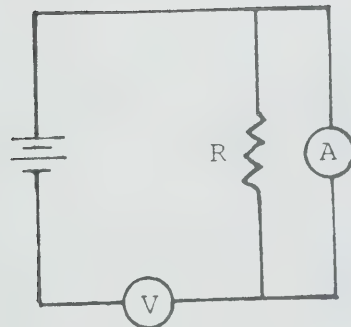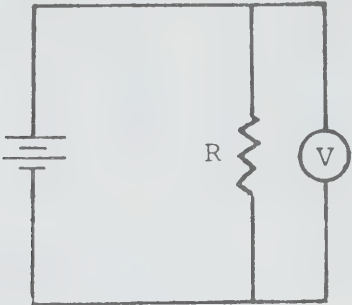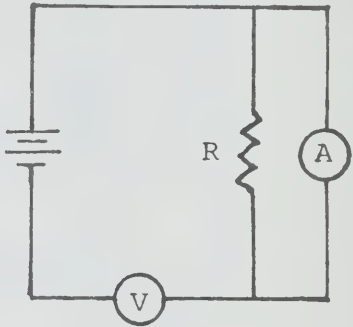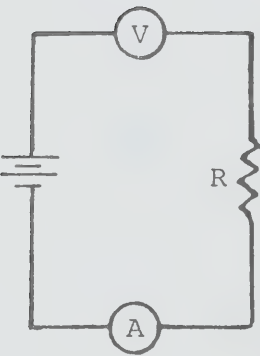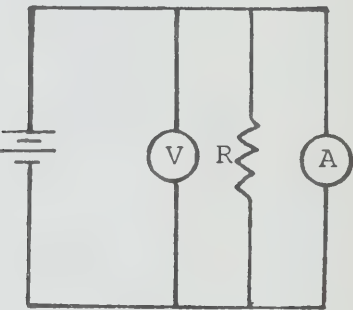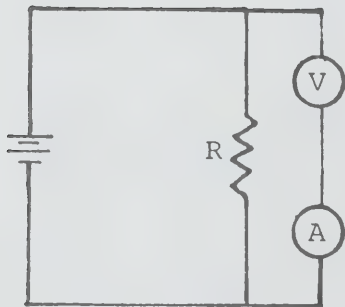
Three 3.0 V batteries, each capable of delivering a
maximum current of 1.0 A, are connected in parallel
and to a load as shown.
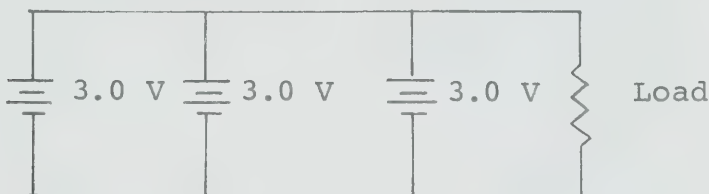
What is the maximum voltage and current supplied to
the load by the combination?

(A)   9.0 V and 1.0 A

(B)   9.0 V and 3.0 A

(C)   3.0 V and 1.0 A

(D)   3.0 V and 3.0 A

(E)   3.0 V and 9.0 A

114

S17A
III.2.h
S17C
IV.2.c

105

F1
A5
A8

(E)

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The power dissipated by a certain resistor is P.
If the potential difference across the resistor
is doubled, the power dissipated will most nearly
be

(A) $\frac{1}{4}$ P

(B) $\frac{1}{2}$ P

(C)   P

(D)   2 P

(E)   4 P

115

A unit of electrical power is the

S17A
III.2.h
S17C
IV.2.c

105

A2

(C)

(A) ampere

(B) coulomb

(C) kilowatt

(D) kilowatt hour

(E) volt

***
-
***

116

One watt equals

S17A
III.2.h
S17C
IV.2.c

105

A2
A11

(D)

(A) 1 C/s

(B) 1 J/A

(C) 1 J/C

(D) 1 J/s

(E) 1 V/A

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117

A 120 V power line is protected by a 15 A fuse.
What is the maximum number of 500 W, 120 V lamps
that can be operated in parallel on this line?

S17A
III.2.h
S17C
IV.2.c

105
104

F1
A8

(C)

(A) 1

(B) 2

(C) 3

(D) 4

(E) 5

***
-
***

118

S17A
III.2.h
S17C
IV.2.c

105

F1
A8

(B)

A power rating of 0.160 kW is given on a Canadian-made electric can opener. What current will flow if it is plugged into a house outlet supplying 110 V?

(A)   0.688 A

(B)   1.45 A

(C)   23.0 A

(D)   110 A

(E)   1.76 x 10⁴ A

***
-
***

119

S17A
III.2.h
S17C
IV.2.c

105

F3
A8

(E)

A Canadian tourist visiting England has in her luggage a hair dryer rated at 600 W and 120 V. When plugged into an electrical outlet rated at 240 V in her London hotel room, the hair dryer will initially operate at close to

(A)   300 W

(B)   600 W

(C)   720 W

(D)   1200 W

(E)   2400 W

***
-
***

120

S17A
III.2.h

S 105

A2

(C)

**
-
**

A common safety device used to protect household electrical circuits against overloading is

(A)   a smoke sensor

(B)   an ammeter

(C)   a fuse

(D)   a thermostat

(E)   a switch

121   A Canadian tourist visiting England has in her
              luggage a hair dryer rated at 600 W and 120 V.
S17A   When plugged into an electrical outlet rated at
III.2.h   240 V in her London hotel room, the hair dryer will
S17C
IV.2.c   (A) operate normally

105   (B) operate at a lower temperature than before

F3   (C) overheat rapidly
A8
              (D) operate at a slightly higher temperature than
(C)   before

**   (E) operate at the same temperature but a slower
-                  speed than before
**

122   Which one of the following electrical quantities
              is matched correctly to its corresponding unit?
S17A
III.2.h   (A) power   -   kilowatt hours
S17C
IV.2.c   (B) energy   -   kilowatts

S 105   (C) potential difference - joules per coulomb

A1   (D) current   -   amperes per second
A2
              (E) resistance   -   ohms per coulomb
(C)

***
-
***

123   Two lamps with different wattage ratings are
              connected in parallel.
S17A
III.2.h   Which one of the following quantities is the same
S17C   for both lamps?
IV.2.c
              (A) current
S 105
              (B) energy dissipated
A2
F1   (C) power

(D)   (D) potential difference

***   (E) resistance
-
***

124

S17A
III.2.h

S17C
IV.2.c

S 105

A8

(D)

***
-
***

Which of the following is <u>not</u> a correct equation for power?

(A) $P = E/t$

(B) $P = V^2/R$

(C) $P = I^2 R$

(D) $P = VIt$

(E) $P = \dfrac{QV}{t}$

125

S17A
III.2.h

S 105

F1
A8

(A)

***
-
***

A household lamp rated at 200 W draws 2.00 A of current. Its resistance is

(A) 50.0 Ω

(B) 100 Ω

(C) 400 Ω

(D) 800 Ω

(E) 1.00×10^4 Ω

126

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(E)

**
-
**

What voltage must be supplied to a 1100 W heating element to drive a current of 5.00 A through it?

(A) 2.42×10^5 V

(B) 5.50×10^3 V

(C) 2.20×10^3 V

(D) 550 V

(E) 220 V

127   When a 12.0 V battery delivers 15.0 A of current,
            the power supplied is

S17A
III.2.h   (A)   180 J
S17C
IV.2.c   (B)   180 W

S 105   (C)   1.25 W

F1   (D)   0.800 J
A8
            (E)   0.800 W
(B)

**
\-
**

128   What current flows through a 1 100 W toaster when
            it is connected to a 110 V line?

S17A
III.2.h   (A) 1.21×10^5 A
S17C
IV.2.c   (B) 9.90×10^2 A

S 105   (C) 1.00×10^1 A

F1   (D)   1.00 A
A8
            (E) 1.00×10^{-1} A
(C)

**
\-
***

129   What maximum power can be drawn from a 120 V source
            with a 15 A fuse?

S17A
III.2.h   (A)   8.0 W
S17C
IV.2.c   (B)   15 W

S 105   (C) 1.8×10^2 W

F1   (D) 8.0×10^2 W
A8
            (E) 1.8×10^3 W
(E)

130

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(C)

At what rate is energy used by a 4.0 Ω resistor which has 120 C of charge passing through it in one minute?

(A) 3.3×10^{-2} W

(B)   8.0 W

(C)   16 W

(D)   30 W

(E) 1.2×10^{2} W

***
–
***

131

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(C)

How much power is drawn by a hair dryer which has a resistance of 14.4 Ω and is connected to a 120 V line?

(A)   1.73 W

(B)   8.33 W

(C)   1.00 kW

(D)   1.73 kW

(E)   207 kW

***
–
***

132

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(A)

What maximum power can be drawn from a 120 V source with a 15.0 A fuse?

(A) 1.80×10^{3} W

(B)   960 W

(C)   135 W

(D)   8.00 W

(E)   0.125 W

133

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(A)

**
–
***

A 60 V battery supplies 1.5 A of current. The power available is

(A)   90 W

(B)   90 J

(C)   40 W

(D)   40 J

(E)   0.025 W

134

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(A)

**
–
***

An electric heater dissipates 84.0 J of electrical energy as heat every two seconds. The power of the electric heater is

(A)   42.0 W

(B)   42.0 J

(C)   84.0 W

(D)   168 W

(E)   168 J

135

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(A)

***
–
***

A household device with a resistance of 5.00 Ω draws 20.0 A of current. The power supplied is

(A) 2.00×10^3 W

(B) 7.50×10^2 W

(C) 5.00×10^2 W

(D) 1.05×10^2 W

(E)   4.00 W

136

S17A
III.2.h
S17C
IV.2.c

S 105

F1
A8

(C)

***
–
***

A current of 3.0 A leaves a 39 V source connected to three resistors as shown in the circuit.
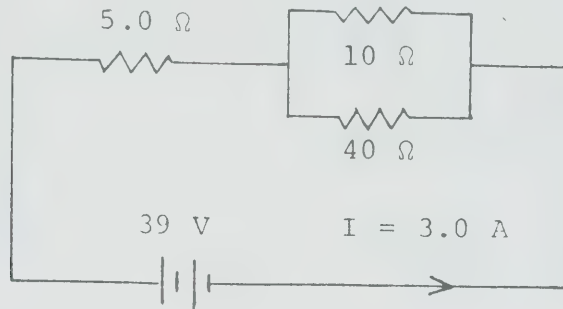
At what rate is energy dissipated in the 10 Ω resistor?

(A)   3.6 W

(B) 5.1×10^1 W

(C) 5.8×10^1 W

(D) 9.0×10^1 W

(E) 1.5×10^2 W

137

S17A
III.2.h
S17C
IV.2.c

106

F1
A8

(A)

***
–
***

An electric motor connected to a 100 V supply draws a current of 20 A. If electricity costs six cents per kilowatt hour, the cost of running the motor for 8.0 h is

(A)   96¢

(B)   64¢

(C)   48¢

(D)   24¢

(E)   1.5¢

138   A 6.00 V battery delivers 2.00 A for 1.00 min.
            The energy delivered is
S17A
III.2.h   (A)   3.00 J

106   (B)   12.0 J

F1   (C)   180 J
A8
             (D)   720 J
(D)
             (E)   1.08 x 10^3 J
***
−
***

139   An electric steam iron is marked "10 A, 110 V".
            How much will it cost to operate the iron for
S17A   one hour if the energy rate is 5.0¢/kW·h?
III.2.h
S17C   (A)   0.55¢
IV.2.c
             (B)   5.5¢
106
             (C)   55¢
F1
A8   (D) $3.30

(B)   (E) $55.00

***
−
***

140   A 60 W light bulb is left burning for 8.0 h. If
            electricity costs six cents per kilowatt hour, the
S17A   cost of the electricity to run the light will be
III.2.h   about
S17C
IV.2.c   (A)   0.29¢

106   (B)   0.96¢

F1   (C)   2.9¢
A8
             (D)   29¢
(C)
             (E) $2.90
***
−
***

141

S17A
III.2.h
S17C
IV.2.c

106

F1
A8

(B)

**
-
***

A 1000 W bulb burns for 2.0 h. At eight cents per kilowatt hour, the cost of electricity is

(A) $160

(B)   16¢

(C)   4.0¢

(D)   0.25¢

(E)   0.063¢

142

S17A
III.2.h
S17C
IV.2.c

106

F1
A8

(D)

***
-
***

In a simple electric circuit 160 J of energy are supplied to a lamp in 10 s. The charge transferred through the circuit is 20 C. The average current is

(A)   0.50 A

(B)   0.80 A

(C)   1.2 A

(D)   2.0 A

(E)   8.0 A

143

S17A
III.2.h
S17C
IV.2.c

106

F1
A8

(B)

***
-
***

In a simple electric circuit 160 J of energy are supplied to a lamp in 10 s. The charge transferred through the circuit is 20 C. The charge moves through a potential difference of

(A)   2.0 V

(B)   8.0 V

(C)   16 V

(D)   32 V

(E)   80 V

144

S17A
III.2.h
S17C
IV.2.c

106

F1
A8

(C)

***
-
***

A refrigerator compressor draws 2.5 A from a 120 V source and operates on average 15 min out of each hour. Calculate the approximate daily cost of operating the refrigerator if the cost of electrical energy is 6.0¢/kW·h.

(A)   0.30¢

(B)   1.1¢

(C)   11¢

(D) $1.10

(E) $11

145

·S17A
III.2.h
S17C
IV.2.c

S 106

A2

(B)

***
-
***

A unit of electrical energy is the

(A)   ampere

(B)   joule

(C)   ohm

(D)   volt

(E)   watt

146

S17A
III.2.h
S17C
IV.2.c

S 106

F1
A8

(A)

**
-
**

How much energy is used by a 12 kW electric motor that runs for 3.0 h?

(A)   36 kW·h

(B)   4.0 J

(C)   4.0 kW·h

(D)   3.0 kW·h

(E)   1.3 kW·h

147

A current of 3.0 A leaves a 39 V source connected to three resistors as shown in the circuit below.
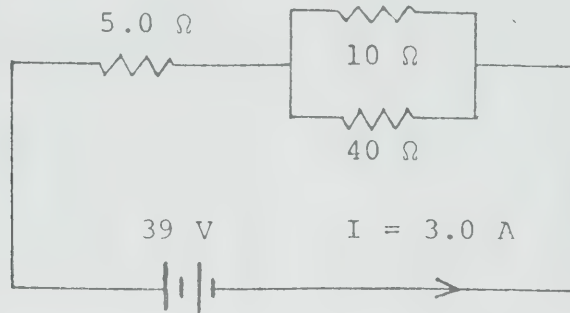
How much energy will the 5.0 Ω resistor use if the circuit is operated for 20 min?

(A) 9.0×10^2 J

(B) 6.1×10^3 J

(C) 5.4×10^4 J

(D) 9.0×10^4 J

(E) 3.7×10^5 J

148

During a lightning flash, 20 C of charge pass through a potential difference of 1.0×10^8 V. Calculate the energy transferred in the flash.

(A) 2.0×10^{-7} J

(B) 5.0×10^6 J

(C) 2.0×10^7 J

(D) 2.0×10^9 J

(E) 2.0×10^{17} J

149   The energy supplied to 15 C of charge by a 2.0 V
               electric cell is

S17A
III.2.h   (A)   0.13 J
S17C
IV.2.c   (B)   7.5 J

S 106   (C)   13 J

F1   (D)   17 J
A8
               (E)   30 J
(E)

**
-
***

150   During a lightning discharge, 30 C of charge move
               through a potential difference of 1.0×10^8 V in
S17A 2.0×10^{-2} s. The total energy released by the
III.2.h   lightning bolt is
S17C
IV.3.c   (A) 1.5×10^{11} J

S 106   (B) 3.0×10^9 J

F1   (C) 6.0×10^7 J
A8
               (D) 3.3×10^6 J
(B)
               (E) 1.5×10^3 J
***
-
***

151   If 60 C of charge expend 150 J of energy going from
               point A to point B in a circuit, then the potential
S17A   difference between A and B is
III.2.h
S17C   (A)   0.40 V
IV.2.c
               (B)   2.5 V
S 106
               (C)   90 V
F1
A8   (D) 2.1×10^2 V

(B)   (E) 9.0×10^3 V

***
-
***

152

S17A
III.2.h
S17C
IV.2.c

S 106

F1
A8

(A)

A 2.0 V battery supplies 1000 C of charge. The energy consumed is

(A) 2.0×10^3 J

(B) 2.0×10^3 W

(C) 5.0×10^2 J

(D) 5.0×10^2 W

(E) 2.0×10^{-3} J

***
‒
***

153

S17A
III.2.f
S17C
IV.2.c

S 106

F1
A8

(E)

If two 110 V bulbs rated at 100 W and 25 W respectively are connected in series in a 110 V line, which one of the following statements is correct?

(A)   The current in the 100 W bulb will be larger than that in the 25 W bulb.

(B)   The current in the 100 W bulb will be smaller than that in the 25 W bulb.

(C)   Both bulbs will light with equal brightness.

(D)   The voltage will divide equally between the two bulbs.

(E)   None of the above is correct.

***
‒
***

154

S17A
III.2.h
S17C
IV.2.c

S 106

F1
A8

(E)

How much energy is consumed when a 60.0 W light bulb is left on for 3.00 h?

(A)   20.0 J

(B)   180 J

(C)   540 J

(D)   10.8 kJ

(E)   648 kJ

***
‒
***

155

S17A
III.2.h
S17C
IV.2.c

S 106

F1
A8

(E)

How much energy does a 60 W bulb use when left on for 2.0 min?

(A)   0.50 J

(B)   20 J

(C)   30 J

(D) 1.2×10^2 J

(E) 7.2×10^3 J

***
–
***

156

S17A
III.3.c

108

A1
B2

(D)

***
–
***

As shown in the diagram below, electrons flow through a copper conductor located between the poles of a horseshoe magnet.
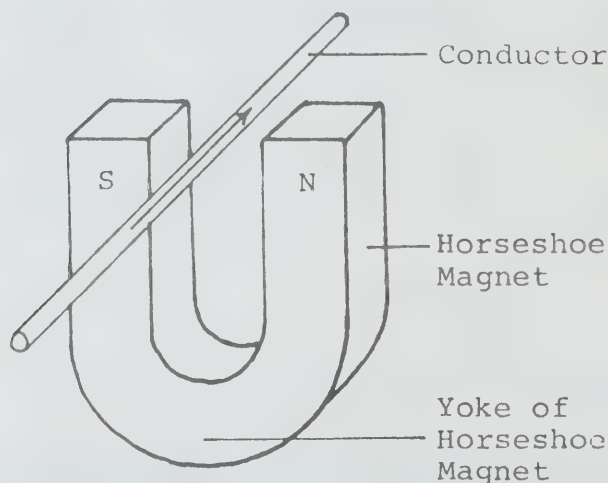
If the conductor is free to move, it will be forced

(A)   toward the N pole of the magnet

(B)   toward the S pole of the magnet

(C)   upward away from both poles of the magnet

(D)   downward toward the yoke of the magnet

(E)   to rotate counterclockwise about its axis

157
S17A
III.3.j

108

A2
A8

(E)

**

‒

**

Consider the following factors for a magnet moving inside a coil:

      I.   the strength of the magnet

      II. the number of turns in the coil

     III. the speed at which the magnet moves

Which of the factors can affect the size of the **voltage** induced in the coil?

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I, II and III

158
S17A
III.3.c

108

A7

(B)

***

‒

***

To use the Left-Hand Helix Rule, you must point your left thumb

(A) toward the S pole of the helix

(B) toward the N pole of the helix

(C) toward the negative terminal of the battery

(C) in the direction of the electron flow

(E) in the opposite direction to the electron flow

159

S17A
III.3.b

S 108

A1

(A)

***

—

***

A steady current of electrons is flowing from east to west through a horizontal copper wire. The N pole of the needle of a pocket compass placed on top of the wire will point toward the

(A)   south

(B)   north

(C)   west

(D)   east

(E)   centre of
       the earth

160

S17A
III.3.a

S 108

A1

(C)

***

—

***
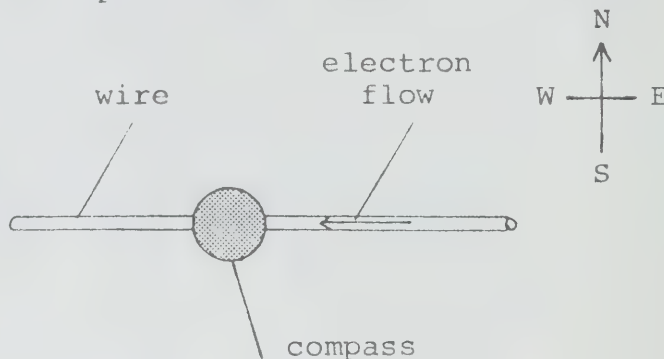
The south seeking pole of a magnet

(A)   has a negative charge

(B)   has a positive charge

(C)   has a neutral charge

(D)   points toward the north magnetic pole of the
       earth

(E)   has none of the above characteristics

161

S17A
III.3.a

S 108

A1

(B)

**

—

**

Which one of the following substances will not be attracted by a magnet?

(A)   cobalt

(B)   copper

(C)   nickel

(D)   soft iron

(E)   steel

162

S17A
III.3.b

S 108

A1

(D)

***
–
***

The reason that some materials are more easily magnetized than others is that

(A)   their molecules are already arranged in magnetic domains

(B)   they have a greater number of magnetic domains

(C)   there are more magnetic domains spinning in one direction than in the opposite direction

(D)   their magnetic domains are more easily lined up in the same direction

(E)   they have stronger magnetic domains

163

S17A
III.3.a

S 108

A1

(C)

***
–
***

When a magnet is strongly heated

(A)   it becomes permanently magnetized

(B)   it becomes an induced magnet

(C)   it loses its magnetism

(D)   its magnetism increases

(E)   its poles are reversed

164

S17A
III.3.a

S 108

A1
B2

(D)

*
–
**

A metal bar MH is brought near the N pole of a compass needle as shown in the diagram. If the N pole is repelled, we may be sure that

(A)   the bar MH is not made of iron, nickel or cobalt

(B)   the bar MH is made of iron, but not magnetized

(C)   the bar MH is made of a non-magnetic material

(D)   the bar MH is a magnet and M is a N pole

(E)   the bar MH is a magnet and M is a S pole

165

S17A
III.3.d

S 108

A1

(B)

**

-

***
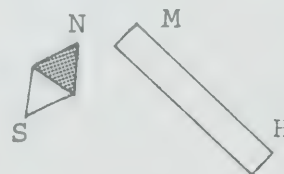
If you reverse the direction of the electron flow through an electromagnet, the electromagnet will

(A)   lose its magnetic properties

(B)   have its polarity reversed

(C)   have its polarity remain the same

(D)   decrease in strength

(E)   not be affected at all

166

S17A
III.3.a

S 108

A1
A2

(A)

**

-

***

The N pole of a magnetic compass usually points to the earth's

(A)   north magnetic pole

(B)   north geographic pole

(C)   south magnetic pole

(D)   south geographic pole

(E)   equator

167

S17A
III.3.h

S 108

A7

(E)

**

-

**

Which of the following statements about a D.C. ammeter is false?

(A)   The ammeter is a device for measuring electrical current.

(B)   The ammeter is connected in a circuit in series.

(C)   The ammeter may have several scales.

(D)   The electrical resistance of the ammeter is very low.

(E)   The positive terminal of the ammeter is connected to the negative terminal of the battery.

168

S17A
III.3.d

S 108

A8

(B)

***
–
***

The diagram shows the polarity of a coil connected to a battery. The terminals of the battery are indicated by X and Y.
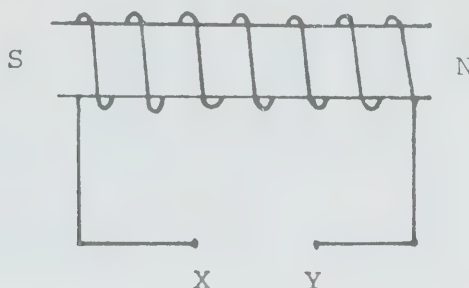
On the basis of the information given, which one of the following conclusions is correct?

(A)   Electrons flow through the coil from end S to end N.

(B)   Y is the negative terminal of the battery.

(C)   There is no magnetic field outside the coil.

(D)   The coil is wound on a core material with high permeability.

(E)   The magnetic field lines inside the coil point from N to S.

169

S17A
III.3.d

S 108

A8

(A)

**
–
***

Which of the following factors does not affect the strength of an electromagnet?

(A)   The direction of the windings.

(B)   The diameter of the core.

(C)   The number of turns in the coil.

(D)   The permeability of the core.

(E)   The resistance of the coil wire.

170   Consider the following changes made to an
             electromagnet:

S17A
III.3.d   I.   increasing the number of turns in
                           the coil
S 108
                    II.   using a copper core instead of an
A8   iron core

(A)   III.   decreasing the current flow in the
                           coil
***
-            The strength of the electromagnet is increased by:
***

             (A)   I only

             (B)   II only

             (C)   III only

             (D)   I and II only

             (E)   I, II and III

171   The brushes of a simple D.C. motor

S17A   (A)   allow the armature to rotate while still being
III.3.o   connected to the battery

S 108   (B)   connect the armature to the permanent magnet

F1   (C)   keep the armature free of dust
A1
             (D)   prevent sparking within the motor
(A)
             (E)   reverse the polarity of the field magnet at
***   regular intervals
-
***

172

S17A
III.3.o

S 108

F1
A1

(D)

The armature of a simple D.C. motor is stationary with both segments of the commutator in contact with both brushes as shown below.

- Brushes
- Commutator
- Field Magnet
- Armature

N   S
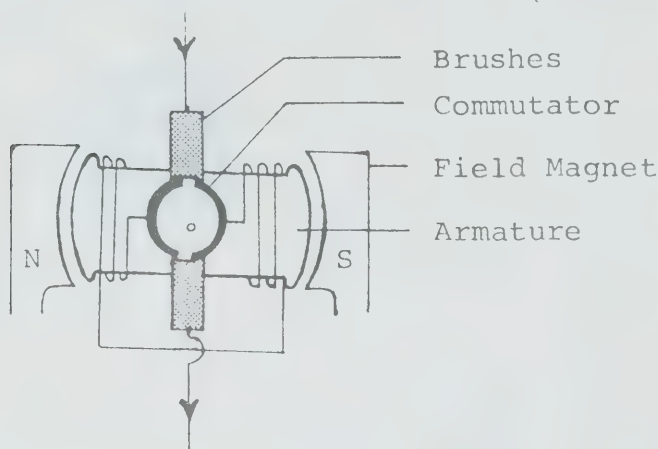
If the brushes are connected to a battery and a current flows in the direction shown, what will happen to the motor?

(A) The armature will turn clockwise.

(B) The armature will oscillate back and forth.

(C) The field magnet will change polarity.

(D) The armature will remain at rest.

(E) The armature will become permanently magnetized.

173

S17A
III.3.d

S 108

F1
A1

(A)

***
-
***

A permanent magnet is held stationary in the centre of a coil connected to a galvanometer. The current reading on the galvanometer will

(A) be steady and zero

(B) be steady and not zero

(C) steadily increase

(D) steadily decrease

(E) steadily increase and then decrease

174   Consider a copper block moving downward toward the
region between two magnetic poles as shown below.

S17A
III.3.j

109

A8
F1

(B)

***
–
***

Copper
block

Y

X

N   S
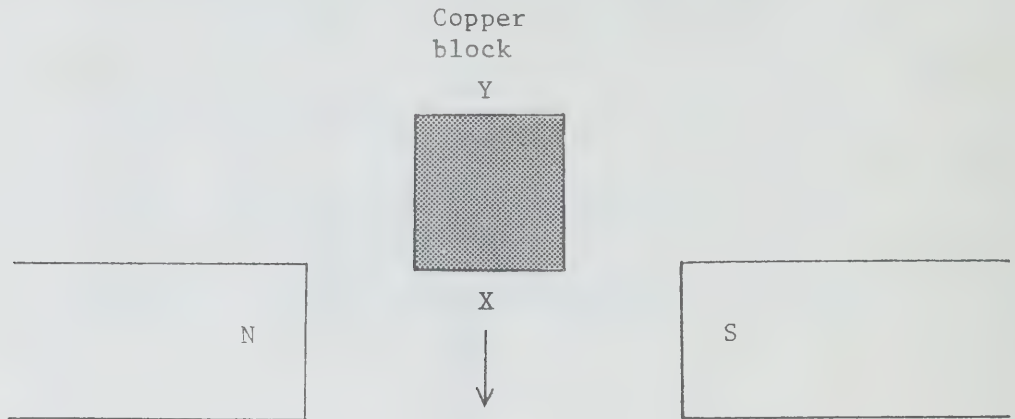
As the block enters the magnetic field between the
poles, electrons in the block will initially

(A)   shift towards you out of the plane of the page

(B)   shift away from you into the plane of the page

(C)   shift toward X

(D)   shift toward Y

(E)   remain where they were

175

S17A
III.3.c

109

A8

(A)

***
-
***

The direction of a magnetic field $\vec{B}$ is from left to right across the page as shown by the vectors. An electron is projected in a direction into and perpendicular to the plane of the page as shown by the circle with a cross inside.
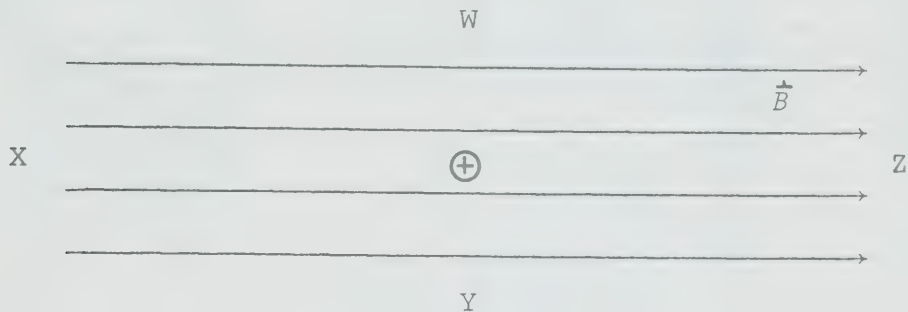
The magnetic force acting on the electron is

(A)   toward W

(B)   toward X

(C)   toward Y

(D)   toward Z

(E)   directly out of the page

176

S17A
IV.1.b

S 109

E2

(D)

**
-
**

Experiments show that cathode rays are deflected by a magnetic field. The most reasonable inference from this observation is that cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   travel at the speed of light

177

S17A

III.3.i

S 109

108

A8

(E)

**

—

***

The diagram represents a primary coil P, carrying a steady current, and a secondary coil S, which is connected to a galvanometer G.
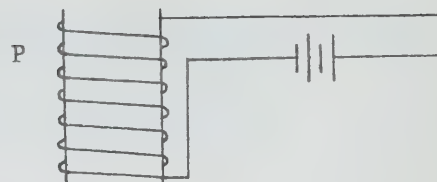
The following steps are performed one after the other:
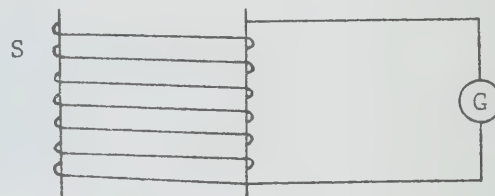
    I. P is pushed rapidly into S

  II. P is held stationary inside S

III. P is withdrawn rapidly from S

  IV. P is held stationary outside S

During which of these steps does G show a steady zero reading?

(A) I only

(B) II only

(C) II and III only

(D) I and III only

(E) II and IV only

1   One ampere is equivalent to one coulomb per second.

S17A   (A)   True
III.2.c
S17C   (B)   False
IV.3.e

101

A2

(A)

**
–
**

2   At constant temperature, the current through an ohmic
           resistor doubles when the potential difference across
S17A   the resistor is doubled.
III.2.e
           (A)   True
102
           (B)   False
A8
A2

(A)

**
–
**

3   The graph below correctly illustrates the relation-
           ship between electrical potential difference V, and
S17A   electric current I for an ohmic conductor.
III.2.e

102

A8
A2
A11

(B)

**
–
**
                        (A)   True

                        (B)   False

4

S17A
III.2.e

S 102

D3
F1

(B)

**

–

**

The resistance of the conductor for which the
potential difference - current relationship is
shown in the graph below is 20 Ω.

(A)   True

(B)   False

5

S17A
III.2.e

S 102

D3
F1
A2

(B)

**

–

**
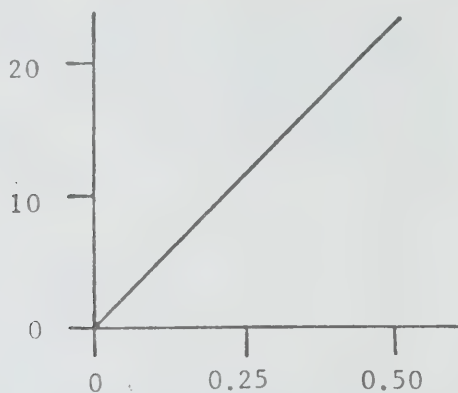
The resistance of the resistor for which the
potential difference-current relationship is
shown in the graph below is 2 Ω.

(A)   True

(B)   False

6

S17A
III.2.e

104

A2
A7
A8

(B)

***
-
***
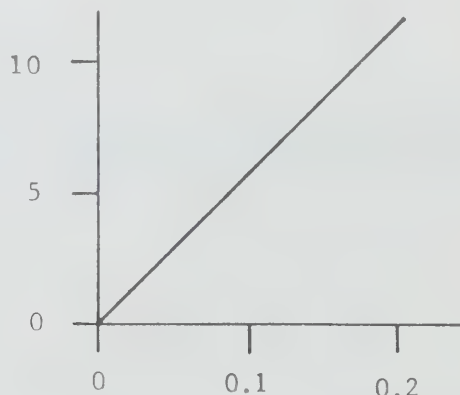
When a voltmeter is correctly connected in a circuit, the lower the resistance of the voltmeter the less it will affect the circuit.

(A) True

(B) False

7

S17A
III.2.e

104

A7
A2

(B)

**
-
**

Consider the following circuit diagram.
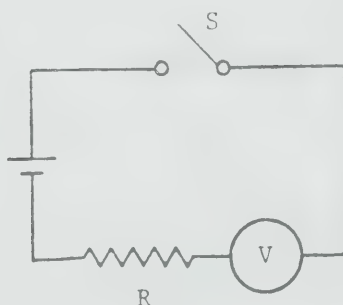
The voltmeter is connected correctly to measure the potential difference across the resistor in the circuit when the switch is closed.

(A) True

(B) False

8   Consider the following circuit diagram.

S17A
III.2.e

104

A7
A2

(B)

**

-
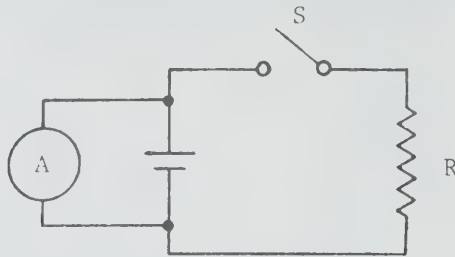
***   The ammeter is connected correctly to measure the
current in the circuit when the switch is closed.

(A)   True

(B)   False

9   Consider the following circuit diagram.

S17A
III.2.e

104

A7
A2

(A)
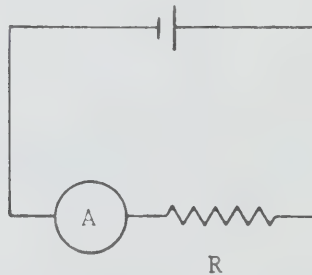
***

-                    The ammeter is connected correctly to measure the
**   current through the resistor in the circuit.

(A)   True

(B)   False

10   Consider the following circuit diagram.
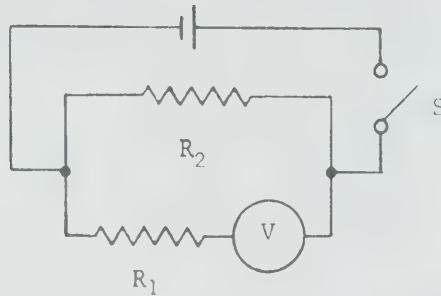
The voltmeter is connected correctly to measure the
potential difference across resistor R_2 when the
switch is closed.

(A)   True

(B)   False

11   Consider the following circuit diagram.
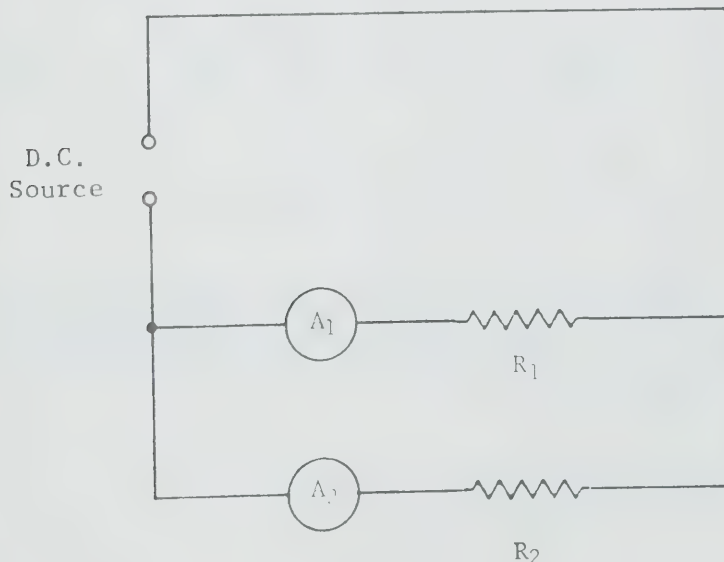
If R_2 has a larger value than R_1, then A_2 will have
a larger reading than A_1.

(A)   True

(B)   False

12

S17A
III.2.g

104

A8
A2

(B)

***
–
***

Two 10 Ω resistors connected <u>in parallel</u> draw a smaller current from a battery than a single 10 Ω resistor would draw.

(A)   True

(B)   False

13

S17A
III.2.g

104

A8
A2

(B)

**
–
**

Two 10 Ω resistors connected <u>in series</u> draw a larger current from a battery than a single 10 Ω resistor would draw.

(A)   True

(B)   False

14

S17A
III.2.g

104

A8
A2
A7

(B)

**
–
**

If several resistors are connected <u>in series</u> in a circuit, the effective resistance of the combination is less than the resistance of any one of those resistors.

(A)   True

(B)   False

15   Assume that the resistors and power supplies shown
              in circuit S and circuit T are identical.

S17A
III.2.g

104

A8
A11
A2

(A)

***

-
**
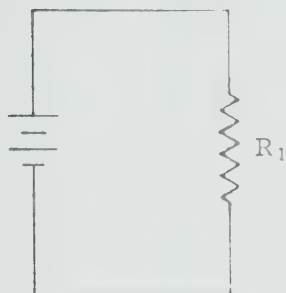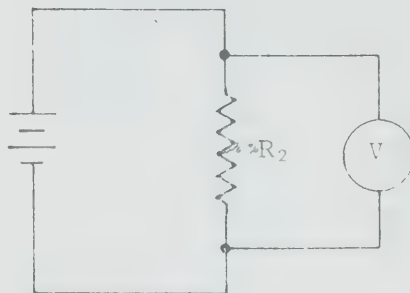
Circuit S   Circuit T

The current through the resistance in circuit S will
be almost equal to the current through the resistance
in circuit T if V has a high resistance.

(A)   True

(B)   False

16   Consider the following circuit diagram.

S17A
III.2.g

104

A11
A8

(A)

***

-
***
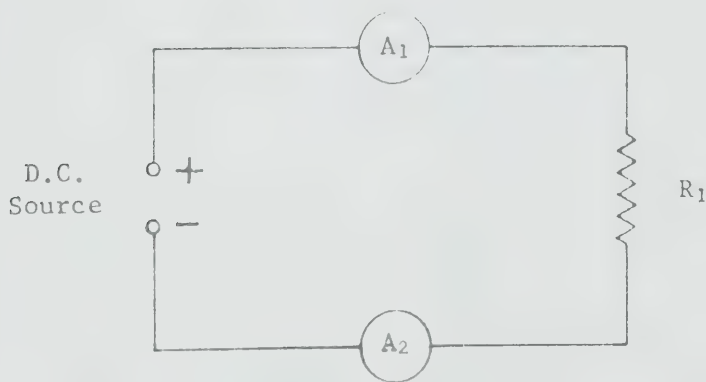
The readings on A_1 and A_2 are the same.

(A)   True

(B)   False

17

S17A

III.2.g

104

A8
A2
A7

(A)

**

–

***

If several resistors are connected <u>in parallel</u> in a circuit, the effective resistance of the combination is less than the resistance of any one of those resistors.

(A)   True

(B)   False

18

S17A

III.2.g

104

A11
A8

(B)

**

–

**

In the circuit diagram below, A_1 and A_2 have the same current reading if the value of R_1 is <u>not</u> equal to the value of R_2.
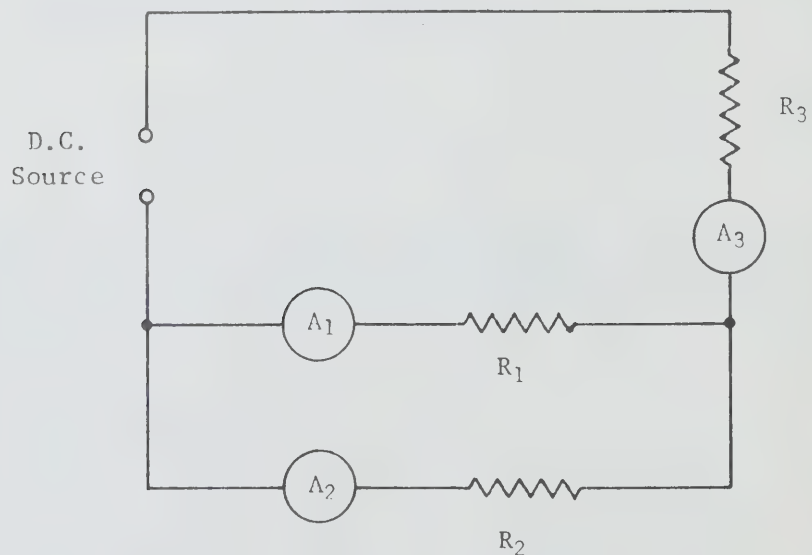
(A)   True

(B)   False

19   Consider the following circuit diagram.

S17A
III.2.g

104

A11
A8

(A)

**

–

**
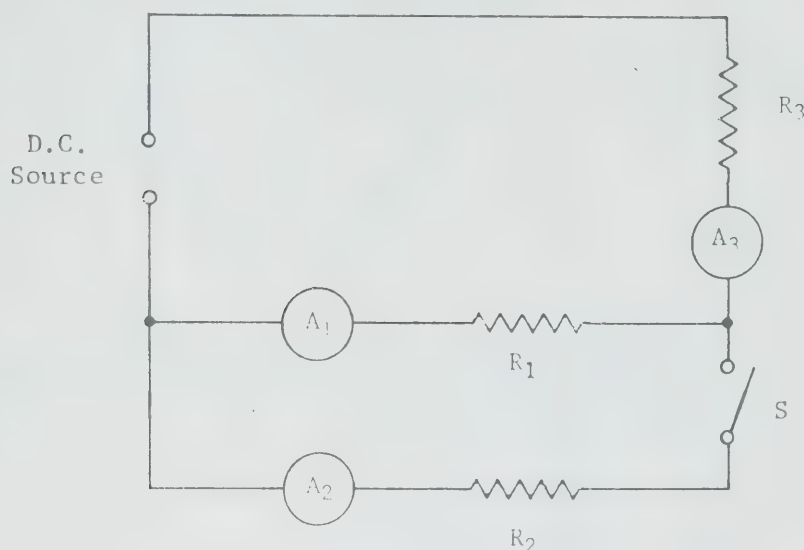
When the switch S is closed, the reading on A_3
will increase.

(A)   True

(B)   False

20   Consider the following circuit diagram.

S17A
III.2.c
S17C
IV.3.e

S 104
S 101

A2
A11
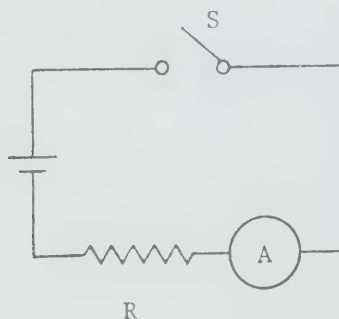
(B)

**

–

**

To minimize the effect that the ammeter will have
on the circuit, it is necessary for the ammeter to
have a very high resistance.

(A)   True

(B)   False

21   Consider the following circuit diagram.

S17A
III.2.c
S17C
IV.3.e

S 104
101

A7
A2
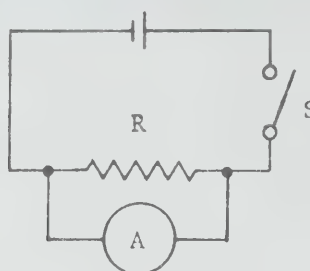
(B)   The ammeter is connected correctly to measure the
             current through the resistor in the circuit when
**   the switch is closed.

\-

**   (A)   True

             (B)   False

22   The label on a particular electrical appliance states
                "120 V, 240 W". The power will be 240 W only if the
S17A   voltage applied is 120 V.
III.2.h
S17C   (A)   True
IV.2.c
                (B)   False
105

A1
A2

(A)

**

\-

**

23

S17A
III.2.h
S17C
IV.2.c

105

A8
A2

(B)

***
—
***

At constant temperature, the power dissipated by an ohmic resistor doubles when the potential difference across the resistor is doubled.

(A)   True

(B)   False

24

S17A
III.2.h

106

F1
A8

(B)

**
—
***

More electrical energy is consumed by a 1 kW hair dryer operating for 1 min than by a 60 W bulb operating for 60 min.

(A)   True

(B)   False

THE ATOM

THE RUTHERFORD MODEL

1

S17A
IV.2.d

125
404

A1
A5

(A)

***
-
***

Rutherford's alpha scattering experiment showed that

(A)   atoms have a tiny central nucleus carrying a
      positive charge

(B)   electrons can be scattered by a nucleus

(C)   electrons are given off in a cathode-ray tube

(D)   gold can be beaten into an extremely thin foil

(E)   protons are almost 2000 times more massive than
      electrons

2

S17A
IV.2.d
S17C
IV.5.a

125

A1
I3

(C)

***
-
***

Which one of the following scientists performed an
experiment which showed that most of the mass of
the atom is concentrated in a relatively small
part of the atom's volume?

(A)   Bohr

(B)   Einstein

(C)   Rutherford

(D)   Thomson

(E)   Millikan

3

S17A
IV.2.a
S17C
IV.1.d

S 125

A1
I3

(E)

To which of the following scientists is credit given for first measuring the ratio of charge to mass for electrons?

(A)   Becquerel

(B)   Einstein

(C)   Roentgen

(D)   Rutherford

(E)   Thomson

***
-
***

4

S17A
IV.2.a
S17C
IV.1.d

S 125

A1
I3

(E)

The discovery of the electron is attributed to

(A)   Becquerel

(B)   Chadwick

(C)   Curie

(D)   Rutherford

(E)   Thomson

***
-
***

5

S17A
IV.2.f
S17C
IV.5.1

SS 125

A1
I3

(B)

The discovery of the neutron is attributed to

(A)   Becquerel

(B)   Chadwick

(C)   Curie

(D)   Rutherford

(E)   Thomson

***
-
***

ENERGY   LEVELS

1

When an electron of an atom possesses the least
amount of energy it can have, it is said to be

S17A

IV.2.g   (A)   in an excited state

S 129   (B)   in a passive state

A2   (C)   in an ionized state

(D)   (D)   in a ground state

***   (E)   in an equilibrium state
-
***

NUCLEAR ENERGY

1

S17A
IV.2.c

S 134

A1
I 3

(A)

***
--
***

Radioactivity was first discovered by Henri Becquerel who

(A) found that photographic plates wrapped in black paper were fogged by nearby uranium samples

(B) wondered why his supply of uranium ore kept changing to lead

(C) found that helium was being generated in his laboratory

(D) suffered from radiation poisoning although he didn't know what it was at the time

(E) saw strange tracks in a cloud chamber

2

S17A
IV.2.f

135

A1

(B)

***
--
***

The element manganese has an atomic number of 25 and a mass number of 55. Its nuclei consist of

(A) 25 protons and 25 neutrons

(B) 25 protons and 30 neutrons

(C) 25 protons and 55 neutrons

(D) 30 protons and 25 neutrons

(E) 55 protons and 25 neutrons

3

S17A
IV.2.f

135

A1

(B)

**
--
***

An atom of atomic number 26 has

(A)   0 electrons and 26 neutrons

(B) 26 electrons and 26 protons

(C) 26 electrons and 26 neutrons

(D) 26 electrons and 52 protons

(E) 52 electrons and 26 neutrons

4

S17A
IV.2.f

135

A1
A2

(C)

***
-
***

An atom with atomic number 94 and mass number 239 possesses

(A)   94 neutrons

(B)   145 protons

(C)   145 neutrons

(D)   239 protons

(E)   239 neutrons

5

S17A
IV.2.f

135

A1
A2

(B)

**
-
**

The atomic number of an element represents the

(A)   number of nucleons in the nucleus

(B)   number of protons in the nucleus

(C)   number of isotopes the element has

(D)   number of electrons the atom loses in becoming ionized

(E)   mass of the nucleons in atomic mass units

6

S17A
IV.2.f

135

A2

(B)

***
-
***

Two isotopes of the same element cannot have the same

(A)   number of protons

(B)   number of neutrons

(C)   number of electrons

(D)   atomic number

(E)   non-zero charge

7   Every isotope of a particular element has the same

S17A   (A)   number of neutrons
IV.2.f
              (B)   mass
135
              (C)   mass number
A2
A1   (D)   number of protons

(D)   (E)   number of nucleons

***
-
***

8   How many neutrons are in the nucleus of $^{239}_{93}Np$?

S17A   (A)   93
IV.2.f
              (B)   146
135
              (C)   239
A2
A4   (D)   332

(B)   (E)   It cannot be determined from the information
                    given.
***
-
***

9   Of the following atoms, the one which has the largest
              number of neutrons is
S17A
IV.2.f   (A) $^{235}_{92}U$

135   (B) $^{239}_{92}U$
397
              (C) $^{239}_{93}Np$
A2
A4   (D) $^{239}_{94}Pu$

(B)   (E) $^{232}_{90}Th$

***
-
***

10   This question involves two statements:

S17A   I. $^{238}_{92}U$ has the same atomic mass as $^{235}_{92}U$.
IV.2.f
                       II. $^{238}_{92}U$ and $^{235}_{92}U$ are both isotopes of
135   uranium.
397
             Which of the following responses correctly describes
A2   the two statements?
A4
             (A)   Both statements are true and one statement can
(D)   be used to explain the other.

***   (B)   Both statements are true, but neither statement
-                  can be used to explain the other.
***
             (C)   Statement I is true.
                   Statement II is false.

             (D)   Statement I is false.
                   Statement II is true.

             (E)   Statement I is false.
                   Statement II is false.

11   This question involves two statements:

S17A   I.   Uranium has an atomic number of 92.
IV.2.f
                       II. The uranium nucleus contains 92 neutrons.
135
397   Which of the following responses correctly describes
             the two statements?
A2
A1   (A)   Both statements are true and one statement can
                   be used to explain the other.
(C)
             (B)   Both statements are true, but neither statement
***   can be used to explain the other.
-
***   (C)   Statement I is true.
                   Statement II is false.

             (D)   Statement I is false.
                   Statement II is true.

             (E)   Statement I is false.
                   Statement II is false.

12   This question involves two statements:

S17A   I.   Protons are located in the nucleus
IV.2.f   of an atom.

136   II.   Neutrons have a greater mass than do
                       protons.
A2
A1   Which of the following responses correctly describes
          the two statements?
(B)
          (A)   Both statements are true and one statement can
***   be used to explain the other.
-
***   (B)   Both statements are true, but neither statement
                can be used to explain the other.

          (C)   Statement I is true.
                Statement II is false.

          (D)   Statement I is false.
                Statement II is true.

          (E)   Statement I is false.
                Statement II is false.

13   This question involves two statements:

S17A   I.   Electrons have no attraction for the
IV.2.e   nucleus of an atom.
S17C
IV.5.a   II.   Atoms are electrically neutral.

136   Which of the following responses correctly describes
126   the two statements?

E2   (A)   Both statements are true and one statement can
A1   be used to explain the other.

(D)   (B)   Both statements are true, but neither statement
                can be used to explain the other.
***
-         (C)   Statement I is true.
***   Statement II is false.

          (D)   Statement I is false.
                Statement II is true.

          (E)   Statement I is false.
                Statement II is false.

15   A symbol for an alpha particle is

S17A   (A) $^4_2$He
IV.2.c
                 (B) $^2_4$He
138
397   (C) $^1_1$H

A1   (D) $_{-1}^{0}$e
A4
                 (E) $^2_1$H
(A)

***
-
***

16   Consider the following quantities:

S17A   I.   mass number
IV.3.a
                         II.   energy
138
406   III.   charge

A7   During the process of radioactive decay, which of
A2   the above quantities will be conserved?

(E)   (A)   I only

***   (B)   II only
-
***   (C)   I and II only

                (D)   II and III only

                (E)   I and III only

17   In the nuclear reaction $^6_3$Li + X $\longrightarrow$ $^7_3$Li

S17A   the symbol X represents
IV.3.a
                (A)   a proton
138
                (B)   a neutron
F1
A4   (C)   an electron

(B)   (D)   a deuteron

***   (E)   a xenon nucleus
-
***

18

S17A
IV.3.a

138
406

F1
A2
A4

(D)

***
−
***

If $^{226}_{88}$Ra gives off an alpha particle, the remaining nucleus is

(A) $^{226}_{89}$Ac

(B) $^{222}_{88}$Ra

(C) $^{226}_{86}$Rn

(D) $^{222}_{86}$Rn

(E) $^{222}_{84}$Po

19

S17A
IV.3.a

138
406

F1
A2
A4

(C)

***
−
***

If $^{230}_{90}$Th gives off an alpha particle, the mass number of the resulting nucleus is

(A)   229

(B)   228

(C)   226

(D)   88

(E)   86

20

S17A
IV.3.a

138
406

F1
A2
A4

(E)

***
−
***

If $^{230}_{90}$Th gives off an alpha particle, the mass number of the resulting nucleus is

(A)   234

(B)   232

(C)   230

(D)   228

(E)   226

21   In the nuclear reaction $^{14}_{6}C \longrightarrow ^{14}_{7}N + X$

S17A   the symbol X represents
IV.3.a
              (A)   a proton
138
399   (B)   a neutron

F1   (C)   an electron
A4
A11   (D)   an alpha particle

(C)   (E)   a gamma ray

***

-

***

22   In the nuclear reaction $^{27}_{13}Al + ^{4}_{2}He \longrightarrow ^{30}_{14}Si + X$

S17A   the missing particle X is
IV.3.a
              (A)   an alpha particle
138
S399   (B)   a positron

F1   (C)   an electron
A4
              (D)   a proton
(D)
              (E)   a neutron
***

-

***

23   In the nuclear reaction $^{24}_{12}Mg + ^{2}_{1}H \longrightarrow X + ^{4}_{2}He$

S17A   the missing particle X is
IV.3.a
              (A) $^{23}_{11}Na$
138
S406
              (B) $^{22}_{10}Ne$
F1
A4
              (C) $^{21}_{11}Na$
(E)
              (D) $^{21}_{10}Ne$
***

-
              (E) $^{22}_{11}Na$
***

24   If $^{225}_{88}$Ra gives off a negative beta particle, the
              remaining nucleus is

S17A
IV.3.a   (A) $^{225}_{89}$Ac

138   (B) $^{224}_{89}$Ac
399
              (C) $^{225}_{88}$Ra
F1
A4   (D) $^{225}_{87}$Fr

(A)   (E) $^{224}_{87}$Fr

***
—
***

25   A beta particle has a charge of

S17A   (A)   negative two
IV.2.c
              (B)   negative one
139
400   (C)   zero

A1   (D)   positive one
A2
              (E)   positive two
(B)

***
—
***

26   Which of the following has the most penetrating
              power?
S17A
IV.2.c   (A)   alpha particles

139   (B)   beta particles
S400
              (C)   cathode rays
A1
A2   (D)   gamma rays

(D)   (E)   X rays

***
—
***

27   X rays have

S17A   (A)   a negative charge
IV.2.c
           (B)   a positive charge
139
404   (C)   no charge

A1   (D)   the same charge as a beta ray
A2
           (E)   the same charge as a helium nucleus
(C)

***
–
***

28   Which of the following substances allows the least
           penetration by beta particles?
S17A
IV.4.b   (A)   aluminum

139   (B)   cardboard
407
           (C)   copper
A1
A2   (D)   iron

(E)   (E)   lead

***
–
***

29   Which one of the following materials requires the
           least thickness to shield against a given amount
S17A   of gamma radiation?
IV.4.b
           (A)   earth
139
S 415   (B)   heavy water

A1   (C)   lead

(C)   (D)   ordinary water

**   (E)   steel
–
**

30

S17A
IV.2.c

139
S 400

A5
A1

(E)

**
–
***

When the three types of nuclear radiation are listed in order of decreasing ionizing capability, the correct order is

(A)   alpha, gamma, beta

(B)   gamma, alpha, beta

(C)   beta, gamma, alpha

(D)   gamma, beta, alpha

(E)   alpha, beta, gamma

31

S17A
IV.2.c

139
402

B4
A7

(D)

***
–
***

The presence of gamma radiation can be detected by

(A)   an electric field

(B)   a lead sheet

(C)   a magnetic field

(D)   a photographic plate

(E)   an uncharged electroscope

32

S17A
IV.2.c

139
401

F1
A2
A7

(B)

**
–
**

A gamma ray source and a Geiger counter are positioned on a laboratory bench. The Geiger counter reading is 300 counts per minute. A sheet of metal 6.00 mm thick is placed between the source and the counter. The reading on the counter is now 75.0 counts per minute.

If the thickness of the metal is reduced to 3.00 mm, the reading on the counter will be closest to

(A)   75.0 counts per minute

(B)   150 counts per minute

(C)   300 counts per minute

(D)   450 counts per minute

(E)   600 counts per minute

33

S17A
IV.2.c

S 139
407

A1

(D)

***
-
***

A beta particle is deflected more than an alpha particle by the same magnetic field because the beta particle

(A) has a larger electric charge

(B) has a smaller electric charge

(C) has a larger mass

(D) has a smaller mass

(E) is moving more slowly

34

S17A
IV.2.c

S 139
400

A1
A2
A7

(E)

***
-
***

Consider the following attributes and values:

  I. a strong magnetic field

  II. a strong negative charge

  III. a strong positive charge

Beta rays can be deflected by

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I, II and III

35

S17A
IV.2.c

S 139
S 410

A1
A2
A7

(B)

***
-
***

A Geiger counter operates on the principle that

(A) the ionization and deionization of certain crystals is accompanied by the emission of light

(B) an electrically charged conductor will lose its charge in the presence of radioactivity

(C) vapours condense more easily on charged particles than on uncharged particles

(D) beta particles deionize a gas through which they pass

(E) a neutral conductor becomes charged in the presence of radioactivity

37   When uranium undergoes fission, most of the energy
                  released comes from the
S17A
IV.3.b   (A)   kinetic energy of the bombarding neutrons

140   (B)   chemical potential energy stored in the
                        uranium atoms
A3
A2   (C)   radioactivity of the uranium nuclei

(E)   (D)   radioactivity of the fission products

***   (E)   conversion of matter into energy
-
***

38   The main purpose of heavy water in the CANDU reactor
                  is to
S17A
IV.3.b   (A)   furnish neutrons for the fission process

141   (B)   undergo fission and release energy

A1   (C)   decrease the speed of fast neutrons

(C)   (D)   undergo fusion and release energy

***   (E)   neutralize the fission products
-
***

39   The function of the control rods in a nuclear reactor
                  is to
S17A
IV.3.c   (A)   increase fission by slowing down the neutrons

141   (B)   decrease the neutrons' energy without absorb-
                        ing them
A1
                  (C)   increase the neutrons' ability to cause fission
(D)
                  (D)   decrease fission by absorbing neutrons
***
-                 (E)   provide the critical mass for the fission
***   reaction

40

S17A
IV.3.b

141

A1
A2

(E)

***
–
***

What has to be done to start the radioactive disintegration of uranium 238?

(A)   Bombard uranium 238 with neutrons.

(B)   Collect a critical mass of the element.

(C)   Position uranium 238 in an atomic pile.

(D)   Remove the control rods in the nuclear reactor.

(E)   Nothing; it disintegrates on its own.

41

·S17A
IV.3.b

141

A1
A2

(A)

**
–
**

The heat energy produced in nuclear reactors is removed by the

(A)   coolant

(B)   control rods

(C)   fuel rods

(D)   condenser

(E)   shielding

42

S17A
IV.3.c

141

A1
A2

(B)

***
–
***

The source of energy in the sun is

(A)   nuclear fission

(B)   nuclear fusion

(C)   radioactivity

(D)   the combustion of carbon

(E)   the oxidation of hydrogen

43

S17A

IV.3.b

141

A1
F1

(D)

***
-
***

The main function of heavy water or graphite blocks
in a nuclear reactor is to

(A)   absorb slow neutrons

(B)   absorb fast neutrons

(C)   act as a source of fast neutrons

(D)   slow down fast neutrons

(E)   shield the operator against radioactivity

44

S17A

IV.3.b

141

A2

(D)

***
-
***

A nuclear fission chain reaction involving $^{235}_{92}U$ is
possible because the reaction produces

(A)   a large amount of strontium

(B)   a large amount of xenon

(C)   a large number of protons

(D)   a large number of neutrons

(E)   a large amount of heat

45

S17A

IV.3.b

141

A2

(D)

**
-
***

The splitting of a nucleus into two parts of roughly
equal mass is called nuclear

(A)   decomposition

(B)   disintegration

(C)   explosion

(D)   fission

(E)   fusion

46

S17A
IV.3.c

141

A2
A1

(D)

**

–

**

How does the process of starting fusion differ from
the process of starting fission?

(A) Fusion requires faster neutrons.

(B) Fusion requires slower neutrons.

(C) Fusion requires a larger critical mass.

(D) Fusion requires a higher temperature.

(E) Fusion requires more heavy nuclei.

47

S17A
IV.3.b

141

A2
A1

(C)

**

–

**

The purpose of a moderator in an atomic reactor is to

(A) provide neutrons for the fission process

(B) react with the uranium to release energy

(C) slow down fast neutrons to increase the
     probability of fission

(D) absorb the dangerous gamma radiation

(E) shield the operator from the dangerous emissions

48

S17A
III.3.b

141

A2
A1

(A)

***

–

***

A chain reaction can be controlled by

(A) absorbing some of the neutrons given off

(B) cooling the fissionable material

(C) shielding with concrete blocks

(D) removing the control rods

(E) using a lead shield

49

S17A
IV.2.b

141

A2
A1

(E)

***
–
***

In a nuclear reactor, the role of the control rods is to

(A) slow neutrons down so that they may be captured by fissionable atoms

(B) hold fissionable uranium or plutonium in position for neutron bombardment

(C) conduct heat from the core so that it does not overheat

(D) replace spent fuel bundles with new fuel bundles

(E) prevent the nuclear reaction in the core from becoming too rapid

50

S17A
IV.3.b

141

A2
A1

(E)

***
–
***

Which of the following elements is not needed in a nuclear fission reactor?

(A) a moderator

(B) a fuel

(C) a coolant

(D) a control device

(E) an accelerator

51

S17A
IV.3.b

141
142

A3
A2

(D)

***
–
***

The nuclear reaction

$$^{240}_{94}Pu \longrightarrow {}^{143}_{54}Xe + {}^{94}_{40}Zr + 3\ {}^{1}_{0}n + Energy$$

is an example of

(A) alpha decay

(B) beta decay

(C) gamma decay

(D) nuclear fission

(E) nuclear fusion

52

S17A
IV.3.b

141
142

A3
A2

(E)

***
—
***

The nuclear reaction $^3_2$He + $^3_2$He → $^4_2$He + 2 $^1_1$H + Energy is an example of

(A)   alpha decay

(B)   beta decay

(C)   gamma decay

(D)   nuclear fission

(E)   nuclear fusion

53

S17A
IV.3.b

S 141

A1

(A)

***
—
***

One reason why so much energy is released when an atomic nucleus splits is that

(A)   some of the mass of the nucleus is converted to energy

(B)   a violent chemical reaction is the main event in nuclear fission

(C)   a chain reaction is inevitable

(D)   it takes a tremendous amount of energy to break a nucleus apart

(E)   all of the mass of the nucleus is converted to energy

54

S17A
IV.3.b

S 142

A1

(B)

***
—
***

The energy from nuclear fission results from

(A)   the fast moving fission fragments

(B)   the disappearance of some mass during the fission process

(C)   the extremely penetrative radiation given off

(D)   the high speed of the neutrons

(E)   the extreme heat in the reactor

1

S17A

IV.2.f

135

A2

(B)

**

\-

**

Different isotopes of the same element have different atomic numbers.

(A)   True

(B)   False

2

S17A

IV.2.f

135

A2

(A)

**

\-

**

The atomic number of an atom is equal to the number of protons in its nucleus.

(A)   True

(B)   False

3

S17A

IV.2.f

135

A2

(A)

**

\-

**

Different isotopes of the same element have different atomic masses.

(A)   True

(B)   False

4

S17A

IV.2.f

135

A2

(A)

**

–

**

Two isotopes of the same element contain the same
number of protons.

(A)   True

(B)   False

5

S17A

· IV.2.f

135

A2

(A)

**

–

***

Two atoms of the same element with the same number
of neutrons also have the same mass number.

(A)   True

(B)   False

6

S17A

IV.2.a

136

A1
A2

(B)

**

–

**

The mass of a proton is less than the mass of an
electron.

(A)   True

(B)   False

7

S17A
IV.2.a

136

A1
A2

(A)

***
--
***

In a neutral atom the total charge of the electrons outside the nucleus is equal but opposite in sign to the total charge of all the particles inside the nucleus.

(A)   True

(B)   False

8

S17A
IV.2.a

136

A1
A2

(A)

**
--
**

In a neutral atom, the total charge of the electrons outside the nucleus is equal but opposite in sign to the total charge of the protons.

(A)   True

(B)   False

9

S17A
IV.3.a

138
406

A7
A2

(A)

During the process of radioactive decay, the mass number of an element is conserved.

(A)   True

(B)   False

10

S17A
IV.3.a

138
406

A7
A2

(A)

During the process of radioactive decay, charge is conserved.

(A)   True

(B)   False

11

S17A
IV.2.c

142

A1
A2

(B)

***
—
***

Nuclear fusion occurs in the CANDU reactor.

(A)   True

(B)   False

12

S17A
IV.2.b

142

A2
A11

(A)

**
—
**

The following reaction is an example of nuclear fission:

$$\, _0^1 n + \, _{92}^{235}U \longrightarrow \, _{56}^{141}Ba + \, _{36}^{92}Kr + 3 \, _0^1 n$$

(A)   True

(B)   False

SOUND

NATURE OF SOUND

1

S17A
II.2.b

SS 143

A2

(B)

***
-
***

The instrument which is used to change electrical
energy to sound energy is the

(A)   amplifier

(B)   loudspeaker

(C)   microphone

(D)   photoelectric cell

(E)   transformer

2

S17A
II.1.b

144

A1

(B)

***
-
***

Three kinds of waves are given below:

     I.   electromagnetic waves

     II. longitudinal waves

   III. transverse waves

The sound of church bells is transmitted to your
ears by

(A)   I only

(B)   II only

(C)   III only

(D)   I and II only

(E)   I and III only

3

S17A
II.1.b

144

A1

(B)

***
—
***

A siren is located due west of your position. The
sound is transmitted to your ear by

(A) air vibrating in a north-south direction only

(B) air vibrating in a west-east direction only

(C) air vibrating in a vertical direction only

(D) air moving continuously westward only

(E) air vibrating in a vertical and a west-east
     direction

4

S17A
II.1.a
S17C
II.1.a

144
58
59

A2
A1

(A)

***
—
***

Which of the following comparisons of light and
sound is false?

(A) Both require a medium for their transmission.

(B) Both obey the same laws of reflection.

(C) Both undergo constructive and destructive
     interference.

(D) Both are forms of energy that travel as waves.

(E) Both change speed in travelling from one
     medium to another.

5

S17A
II.1.b

S 144

A1

(D)

*
—
**

Which one of the following cannot transmit sound?

(A) alcohol

(B) fiberglas

(C) iron

(D) vacuum

(E) wood

6

S17A
II.1.b

S 144

A1

(E)

*
—
*

Which one of the following <u>cannot</u> transmit sound?

(A)   liquid air

(B)   gaseous oxygen

(C)   liquid water

(D)   solid steel

(E)   perfect vacuum

7

S17A
II.1.c

S 145

A2
A1

(D)

***
—
***

The speed of sound depends most on

(A)   the amplitude of the sound wave

(B)   the intensity of the sound

(C)   the loudness of the sound

(D)   the transmitting medium

(E)   the pitch of the sound

8

S17A
I.2.a
S17C
I.3.c

147
27

A3
F1

(A)

***
—
—

A depth finder emits a burst of sound from the bottom of a ship. The time required for the sound to travel down through the water, strike the ocean bottom and reflect back to the ship is 0.20 s. The speed of sound in water at the time was 1400 m/s.

The depth of the water under the ship is

(A) 1.4×10^2 m

(B) 2.8×10^2 m

(C) 7.0×10^2 m

(D) 7.0×10^3 m

(E) 1.4×10^4 m

9

S17A
II.1.c

148

A8

(C)

***

-

***

If λ represents the wavelength of a wave, v its speed, and T its period, which one of the following relationships is correct?

(A) $\lambda = \dfrac{1}{T}$

(B) $\lambda = \dfrac{1}{v}$

(C) $\lambda = vT$

(D) $\lambda = \dfrac{v}{T}$

(E) $\lambda = \dfrac{T}{v}$

10

S17A
II.1.c

148

F1
A8

(E)

***

-

***

A sound wave of wavelength 0.400 m has a speed of 360 m/s. The frequency of the sound is

(A)   0.400 Hz

(B)   9.00 Hz

(C)   144 Hz

(D)   360 Hz

(E)   900 Hz

11

S17A
II.1.c

148

F1
A8

(E)

***

-

***

A sound wave of wavelength 0.500 m has a speed of 350 m/s. The frequency of the sound is

(A) 1.40×10^{-3} Hz

(B)   7.00 Hz

(C)   175 Hz

(D)   350 Hz

(E)   700 Hz

12

S17A
I.2.a

148

F1
A8

(D)

***
–
***

Vibrations are created at one end of a solid metal rod by touching the end with the stem of a vibrating tuning fork. After a time of 0.001 s the vibrations are detected at the other end.

If the metal rod is 1.0 m long and the tuning fork has a frequency of 200 Hz, the wavelength of the vibrations in the metal rod is most nearly

(A)   0.2 m

(B)   0.5 m

(C)   2 m

(D)   5 m

(E) 2×10^5 m

13

S17A
II.1.c

148

F1
A8

(B)

**
–
***

A vibrating object with a frequency of 200 Hz produces sound which travels through air at 360 m/s. The number of metres separating adjacent compressions in the sound wave is

(A)   0.900

(B)   1.80

(C)   3.60

(D)   7.20

(E)   200

14

S17A
II.1.c

148

F1
A8

(B)

***
–
***

A 100 Hz tuning fork sends out waves having a wavelength of 3.32 m at 0°C. The distance between successive compressions at this temperature is

(A)   1.66 m

(B)   3.32 m

(C)   6.64 m

(D) 1.33×10^1 m

(E) 3.32×10^4 m

15   If the speed of sound in air is 3.3×10^2 m/s, then
                the wavelength of the note E (3.2×10^2 Hz) is
S17A   closest to
II.1.c
                (A) 5.0×10^{-1} m

148
                (B)   1.0 m

F1
A8   (C)   1.5 m

(B)   (D) 1.0×10^4 m

***   (E) 1.0×10^5 m
-
***

16   The Universal Wave Equation is

S17A   (A) $v = T\lambda$
II.1.c

S 148   (B) $v = \dfrac{f}{\lambda}$

A8   (C) $f = v\lambda$

(D)   (D) $v = f\lambda$

***   (E) $T = \dfrac{1}{f}$
-
***

17   A period of 0.050 s represents a frequency of

S17A   (A)   0.050 Hz
II.1.a
                (B)   20 Hz
S 148
69   (C)   50 Hz

F1   (D) 1.0×10^2 Hz
A8
                (E) 5.0×10^2 Hz
(B)

***
-
***

18   If the period is 1.25 x 10^{-2} s, the frequency is

S17A   (A)   80.0 Hz
II.1.a
             (B)   1.25 x 10^2 Hz
S 148
             (C)   1.25 x 10^{-2} Hz
F1
A8   (D)   8.00 Hz

(A)   (E)   800 Hz

***
-
***

19   Which one of the following statements is <u>false</u>?

S17A   (A)   A sound wave transmits energy.
II.1.b
             (B)   A sound wave consists of compressions and
149   rarefactions.
144
             (C)   A sound wave travels faster in warm air than
A1   in cold air.

(D)   (D)   A sound wave travels faster in a vacuum than
                    in air.
***
-            (E)   A sound wave obeys the laws of reflection.
***

20   The average speed of sound outside is

S17A   (A)   largest in the spring
II.1.c
             (B)   largest in the summer
S 149
             (C)   largest in the autumn
A1
             (D)   largest in the winter
(B)
             (E)   the same for all seasons
***
-
***

21

S17A

II.1.c

S 149

F1
A8

(D)

***
–
***

If the temperature of the air increases by 15°C,
the speed of sound in the air

(A)   decreases by 0.60 m/s

(B)   increases by 0.60 m/s

(C)   decreases by 9.0 m/s

(D)   increases by 9.0 m/s

(E)   increases by 24 m/s

1

S17A
II.1.a

143

A2

(A)

*
–
*

A vibrating object is necessary for the production of sound.

(A)   True

(B)   False

2

S17A
II.1.a

144

A1
A2

(B)

***
–
***

Sound is transmitted through the air by means of transverse waves.

(A)   True

(B)   False

3

S17A
II.2.a

144

E5
A2

(B)

***
–
***

The fact that beats are produced by two tuning forks of slightly different frequencies is evidence that sound is transmitted by a longitudinal wave rather than by a transverse wave.

(A)   True

(B)   False

4

S17A
II.1.b

149

A5
A2

(A)

**
-
***

On a warm day, the speed of sound in air is greater
than on a cool day.

(A)   True

(B)   False

5

S17A
II.1.b

149

A5
A2

(A)

**
-
**

The speed of sound in air increases as the temperature
increases.

(A)   True

(B)   False

MUSIC

1

S17A
II.1.d

153

A2

(C)

**
-
**

Which one of the following factors determines the pitch of a sound?

(A)   the amplitude of the sound wave

(B)   the distance of the sound wave from the source

(C)   the frequency of the sound wave

(D)   the phase of different parts of the sound wave

(E)   the speed of the sound wave

2

S17A
II.1.c

S 153

A2

(A)

***
-
***

A certain note is produced when a person blows air into an organ pipe. If the person blows slightly harder, the most probable change will be that the sound wave will increase in

(A)   amplitude

(B)   frequency

(C)   pitch

(D)   speed

(E)   wavelength

3

S17A
II.1.a

154

A1
A2

(B)

**
–
**

The pitch of a pure note emitted by a tuning fork depends on

(A)   the amplitude of the prongs

(B)   the frequency of the prongs

(C)   the intensity of the note

(D)   the loudness of the note

(E)   the quality of the note

4

S17A
II.2.a

158

A1
A2

(E)

**
–
***

In order for two sound waves to produce audible beats, it is essential that the two waves have

(A)   the same amplitude

(B)   the same frequency

(C)   the same number of overtones

(D)   slightly different amplitudes

(E)   slightly different frequencies

5

S17A
II.2.a

159

A3

(E)

*
–

A tuning fork of frequency 384 Hz is sounded at the same time as a guitar string. 30 beats are heard in 10 s. The frequency of the string in hertz is

(A)   38.4

(B)   354 or 414

(C)   369 or 399

(D)   374 or 394

(E)   381 or 387

6

S17A
II.2.a

Two tuning forks, having frequencies of 310 Hz and 320 Hz respectively, are sounded together loudly. An observer standing at a point several metres away will hear

S 159

F1

(E)

**

-

***

(A)   continuous silence

(B)   a steady loud sound

(C)   a sound whose frequency is 315 Hz

(D)   a sound with 20 beats per second

(E)   a sound with 10 beats per second

7

S17A
II.2.b

162

A3

(B)

**

-

**

Four masses are suspended by strings from a flexible cord as shown below.
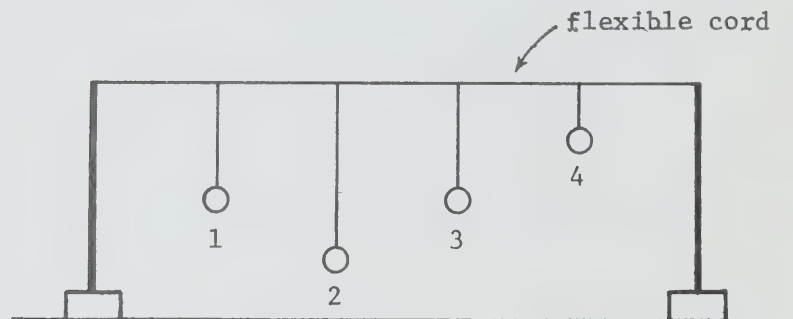
If mass 1 is set into vibration, which of the other masses will vibrate with the same frequency as mass 1?

(A)   mass 2 only

(B)   mass 3 only

(C)   mass 4 only

(D)   masses 2, 3 and 4

(E)   none of the masses

8

S17A
II.2.b

S 161

A2

(E)

***
-
***

The increase in amplitude of a vibrating object, due to periodic impulses of the same frequency as the natural frequency of the vibrating object, is called

(A)   beats

(B)   fundamental

(C)   interference

(D)   overtone

(E)   resonance

9

S17A
II.2.b

163

A1
A8

(B)

**
-
***

A tuning fork, producing sound waves of wavelength λ, causes resonance in a closed air column. The length of the air column could <u>not</u> be

(A)   1/4 λ

(B)   2/4 λ

(C)   3/4 λ

(D)   5/4 λ

(E)   7/4 λ

10

S17A
II.2.b

163
148

F1
A8

(A)

***
-
***

A tuning fork of frequency 440 Hz resonates with an air column closed at one end. The speed of sound in air is 330 m/s.

What is the shortest air column to the closest cm that resonates with this tuning fork?

(A)   19 cm

(B)   33 cm

(C)   38 cm

(D)   67 cm

(E)   75 cm

11

S17A
II.2.b

163

F1
A8

(A)

***
–
***

An air column, closed at one end, resonates with a
400 Hz tuning fork. If the speed of sound in air is
320 m/s, the shortest length the air column can be is

(A)   0.20 m

(B)   0.40 m

(C)   0.80 m

(D)   1.60 m

(E)   3.20 m

12

S17A
II.2.b

164

A8
F1

(E)

*
–

The shortest length of pipe, closed at one end, that
resonates when a vibrating tuning fork is held near
its open end is 20 cm. The wavelength of the
sound is

(A)   5 cm

(B)   10 cm

(C)   20 cm

(D)   40 cm

(E)   80 cm

13

S17A
II.2.b

164

F1
A8

(E)

***
–
***

The shortest resonant length of a certain air column
closed at one end is 20 cm. The wavelength of the
sound waves is

(A)   5.0 cm

(B)   10 cm

(C)   20 cm

(D)   40 cm

(E)   80 cm

14

S17A
II.2.a

S 166

A1
A3

(C)

***
-
***

A stationary loud speaker sends sound waves of
constant frequency along the line SR toward a
solid wall 10 m away.
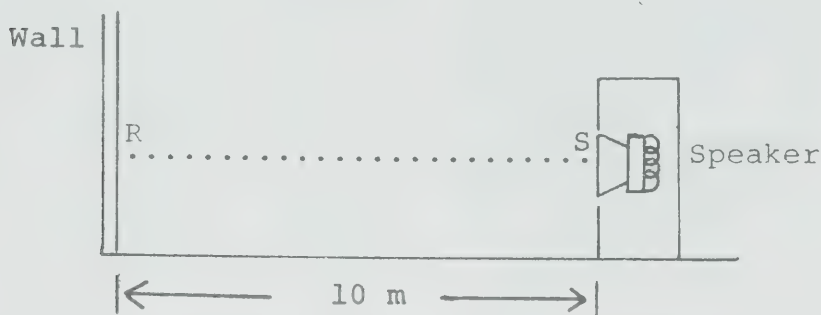
An observer, on moving from R toward S at constant
speed, will hear sound of

(A) constant frequency and intensity

(B) constant frequency and uniformly increasing
intensity

(C) constant frequency and periodically changing
intensity

(D) periodically changing frequency and intensity

(E) periodically changing frequency and uniformly
increasing intensity

15

S17A
II.2.b

S 167

F1
A2
A8

(D)

***
-
***

A stretched string vibrates with a fundamental
frequency of 100 Hz. The frequency of the second
harmonic is

(A) 25 Hz

(B) 50 Hz

(C) 100 Hz

(D) 200 Hz

(E) 400 Hz

16

S17A
II.2.a

169

F1
A3

(D)

*
–
–

The first resonant length of a tube, open at both ends, is 40 cm. The wavelength of the sound which will produce this resonance is

(A)   10 cm

(B)   20 cm

(C)   40 cm

(D)   80 cm

(E)   160 cm

17

S17A
II.2.a

171

F1
A11
A8

(B)

***
–
***

A stationary loud speaker sends sound waves of frequency 300 Hz at a speed of 300 m/s along the line SR toward a reflective solid wall. An observer walks from R directly toward S.
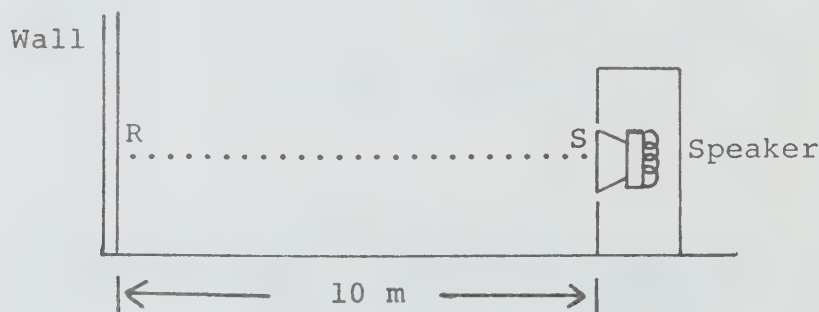
How far apart are the maxima that the observer hears?

(A)   0.25 m

(B)   0.50 m

(C)   1.0 m

(D)   2.0 m

(E)   4.0 m

18

S17A
II.2.b

172

F1
All

(B)

**
-
***

The diagrams below represent four different standing wave patterns in air columns of equal length.

I   II   III   IV
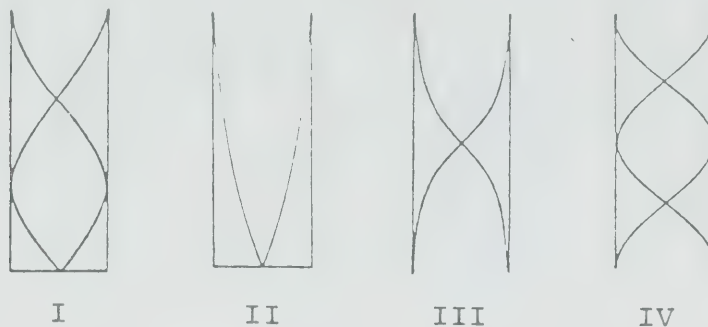
Which of the columns will produce the sound having the longest wavelength?

(A)   I

(B)   II

(C)   III

(D)   IV

(E)   All columns are producing sound of the same wavelength.

19

S17A
II.2.b

172

F1
All

(A)

***
-
***

The diagrams below represent four different standing wave patterns in air columns of equal length.

I   II   III   IV
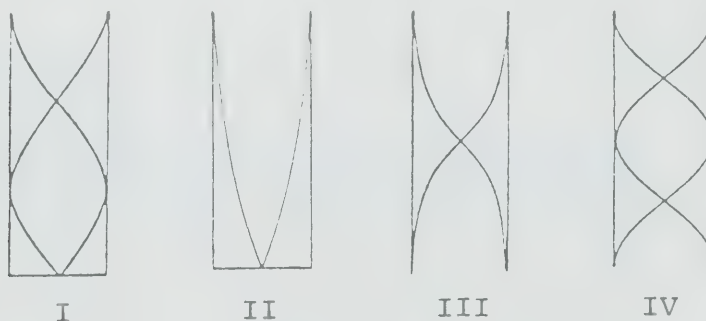
Which of the standing wave patterns are possible?

(A)   all of them

(B)   all except I

(C)   all except II

(D)   all except III

(E)   all except IV

20

S17A
II.2.b

172

F1
A11

(D)

***
–
***

The diagrams below represent four different standing wave patterns in air columns of equal length.

I   II   III   IV
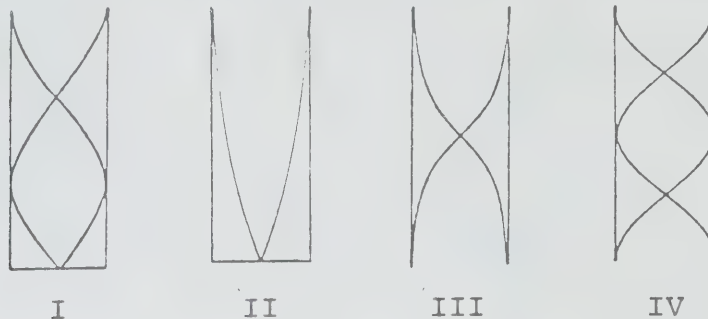
Which of the columns is/are vibrating at its/their fundamental frequency?

(A)   I only

.(B)   II only

(C)   I and II only

(D)   II and III only

(E)   III and IV only

21

S17A
II.2.b

173

F1
A8

(C)

***
–
***

An air column closed at one end filled with argon resonates with a 200 Hz tuning fork. The shortest resonant length is 42.5 cm. The speed of the sound must be

(A)   85.0 m/s

(B)   170 m/s

(C)   340 m/s

(D)   470 m/s

(E)   940 m/s

22

S17A
II.2.b

172

F1
A11

(D)

**

−

***

The diagrams below represent four different standing wave patterns in air columns of equal length.

    I   II   III   IV
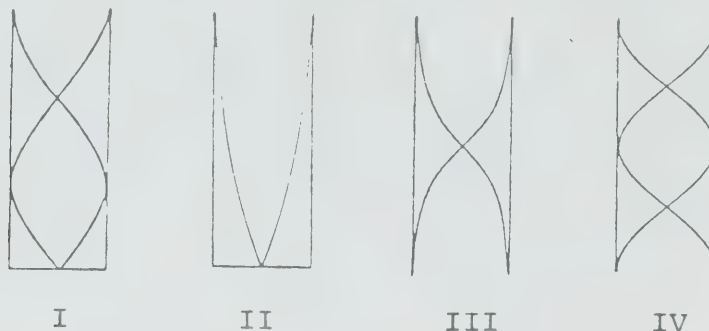
Which of the columns will produce the note having the highest pitch?

(A)   I

(B)   II

(C)   III

(D)   IV

(E)   All columns produce notes having the same pitch.

23

S17A
II.2.a

176

A8

(B)

***

−

***

The fundamental frequency of a small diameter organ pipe of length l is

(A)   directly proportional to l

(B)   inversely proportional to l

(C)   inversely proportional to l^2

(D)   directly proportional to l^2

(E)   independent of l

24

S17A
II.2.b

172

F1
A11

(E)

***
–
***

The diagrams below represent four different standing
wave patterns in air columns of equal length.
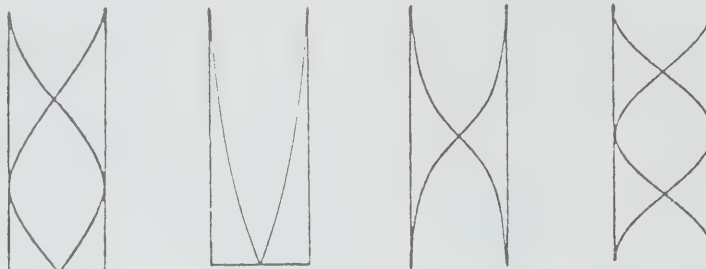
I   II   III   IV

Which of the columns will produce the sound having
the greatest speed?

(A)   I

(B)   II

(C)   III

(D)   IV

(E)   All columns produce sounds having the same
      speed.

25

S17A
II.2.a

176

A8

(A)

***
–
***

Organ pipe X, which is open at both ends, is twice
as long as organ pipe Y, which is closed at one end.
The ratio of the fundamental frequency of pipe X to
the fundamental frequency of pipe Y is

(A)   1:1

(B)   1:2

(C)   2:1

(D)   1:4

(E)   4:1

X   Y

26

S17A
II.1.a

179

F1
A8

(B)

***
-
***

A stretched string vibrates with a frequency of
1 000 Hz. If the same string is to vibrate with
twice the frequency, the tension should be

(A)   increased by a factor of 2

(B)   increased by a factor of 4

(C)   increased by a factor of $\sqrt{2}$

(D)   reduced by a factor of 1/2

(E)   reduced by a factor of $1/\sqrt{2}$

27

S17A
II.1.a

179

F1
A8

(D)

***
-
***

A string 80.0 cm long has a fundamental frequency
of 300 Hz. If the length of the string is changed
to 40.0 cm without changing the tension, the
fundamental frequency will be

(A)   150 Hz

(B) $300/\sqrt{2}$ Hz

(C) $300\sqrt{2}$ Hz

(D)   600 Hz

(E) 1.20×10^3 Hz

1

S17A
II.2

157

F1
A2

(B)

**

—

**

A violinist plays a note whose fundamental frequency
is 220 Hz.   The third harmonic of that note is
880 Hz.

(A)   True

(B)   False

2

S17A
II.2.a

158

A3
A2

(B)

**

—

**

Beats are produced when two tuning forks of the same
frequency are sounded at the same time.

(A)   True

(B)   False

3

S17A
II.2.a

159

A3
F1

(A)

**

—

***

If tuning forks of 256 Hz and 258 Hz are sounded at
the same time, 4 beats will be heard in 2 s.

(A)   True

(B)   False

4

S17A
II.2.a

159

A3
F1

(B)

**
-
**

If tuning forks of 256 Hz and 258 Hz are sounded at the same time, 2 beats will be heard in 2 s.

(A)   True

(B)   False

5

S17A
II.2.a

159

A3
F1

(B)

**
-
**

If tuning forks of 256 Hz and 258 Hz are sounded at the same time, 8 beats will be heard in 2 s.

(A)   True

(B)   False

6

S17A
II.2.b

162

A3
A2

(A)

*
-
**

One vibrating body can set another body into vibration if the natural frequencies of the two bodies are the same.

(A)   True

(B)   False

7

S17A
II.2.b

163

F1
A8

(B)

***
–
***

The difference between consecutive resonant lengths
of an air column closed at one end is one quarter of
the wavelength of the sound in the column.

(A)   True

(B)   False

.

8

S17A
II.2.b

164

F1
A8

(B)

**
–
**

An organ pipe closed at one end will resonate if its
length is equal to half of the wavelength of the
sound in the pipe.

(A)   True

(B)   False

9

S17A
II.2.b

168
163

F1
A2

(A)

***
–
***

If an air column of length x closed at one end
resonates at a given frequency, then an air column
of length $2x$ open at both ends will resonate at the
same frequency.

(A)   True

(B)   False

10

S17A
II.2.b

168
163

F1
A2

(B)

**
–
***

If an air column of length x <u>closed at one end</u> resonates at a given frequency, then an air column of length ½x <u>open at both ends</u> will resonate at the same frequency.

(A)   True

(B)   False

11

S17A
II.2.b

169
164

F1
A8

(A)

***
–
**

If a source of sound of wavelength λ is held near any air column (open or closed), the difference between successive lengths of the air column at which resonance will occur is ½ λ.

(A)   True

(B)   False

12

S17A
II.2.b

169

F1
A8

(A)

**
–
**

The difference between consecutive resonant lengths of an air column open at both ends is one half of the wavelength of the sound in the column.

(A)   True

(B)   False

13

S17A
II.2.b

169

F1
A8

(B)

**

—

***

An organ pipe open at both ends will resonate if its
length is equal to three quarters of the wavelength
of the sound in the pipe.

(A)   True

(B)   False

14

S17A
II.2.b

179

A8
A5
A2

(B)

**

—

**

A vibrating steel wire of a certain length, thickness
and tension is sounded. A second steel wire of the
same length and tension, but double the thickness, is
then sounded.

The frequency of the note produced by the second
wire is double the frequency produced by the first.

(A)   True

(B)   False

ELECTROMAGNETISM

MAGNETS

1

S17A
III.3.a

198

A6

·(D)

Four metals are listed below:

      I.   cobalt

     II.   copper

   III.   iron

    IV.   nickel

Which of these metals are ferromagnetic?

(A)   I and II only

(B)   I and III only

(C)   III and IV only

(D)   I, III and IV only

(E)   II, III and IV only

2

S17A
III.3.b

198

A10

(C)

***
–
***

Which of the following substances is <u>most</u> effective
in shielding a watch from the influence of a magnet?

(A)   glass

(B)   gold

(C)   iron

(D)   lead

(E)   transparent plastic

3

S17A
III.3.a

198

B4

(B)

***
–
***

The polarity of an unmarked magnet can be determined by using

(A)   a charged ebonite rod

(B)   a compass

(C)   an electroscope

(D)   another unmarked magnet

(E)   iron filings

4

S17A
III.3.a

S 198

A1

(C)

***
–
***

The application of heat to a magnet will

(A)   not affect the magnet.

(B)   make the magnet stronger.

(C)   make the magnet weaker.

(D)   reverse the polarity of the magnet.

(E)   make the magnet a permanent magnet.

5

S17A
III.3.a

S 198

A1
A2

(D)

***
–
***

Three substances with high magnetic permeability are

(A)   aluminum, steel and copper

(B)   cobalt, nickel and aluminum

(C)   gold, silver and platinum

(D)   iron, cobalt and nickel

(E)   iron, cobalt and copper

6

S17A
III.3.a

S 198

A2

(B)

***
-
***

A bar of soft iron held near the north pole of a magnet becomes temporarily magnetized by a process called

(A)   conduction

(B)   induction

(C)   permeability

(D)   retentivity

(E)   saturation

7

S17A
III.3.a

S 198

A4
A7

(E)

***
-
***

A soft iron nail is stroked from head to point with the S pole of a magnet. The point of the nail becomes

(A)   the same pole as the head

(B)   permanently magnetized by induction

(C)   demagnetized by friction

(D)   a S pole of a magnet

(E)   a N pole of a magnet

8

S17A
III.3.a

S 199

A1

(B)

**
-
**

Which of the following will <u>not</u> be attracted by a magnet?

(A)   a cobalt cube

(B)   a copper penny

(C)   a lodestone

(D)   a nickel wire

(E)   a soft-iron keeper

9

S17A
III.3.a

199

A2
A8

(C)

*
–
**

A student who is summarizing the results of an experiment with two magnets makes the following statements:

    I.   The N poles of the two magnets repel.

    II. The S poles of the two magnets attract.

    III. The S pole of one magnet attracts the N pole of the other magnet.

Which of the above statements is/are correct.

(A) I only

(B) I and II only

(C) I and III only

(D) II and III only

(E) I, II and III

10

S17A
III.3.a

199

F1
A8

(C)

**
–
***

A metal bar XY is brought near the N pole of a magnetic compass as shown in the diagram. If the N pole is repelled, we may be sure that the bar XY is

(A) not made of iron, nickel, or cobalt

(B) made of iron, but is not magnetized

(C) a magnet and X is a north-seeking pole

(D) a magnet and X is a south-seeking pole

(E) made of any metal other than iron, nickel or cobalt
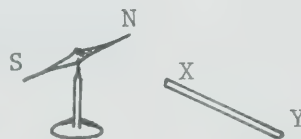
11   The magnetic field lines about a bar magnet

S17A   (A)   form closed curves
III.3.c
             (B)   attract each other
200
             (C)   cross one another near the poles

A3   (D)   are more numerous near the N pole than near the
A5   S pole

(A)   (E)   leave the S pole and enter the N pole

***
−
***

12   The state reached by a magnet when all its atoms or
             molecules have been completely aligned by an
S17A   external field is called magnetic
III.3.b
             (A)   conduction
S 200
             (B)   induction
A2
             (C)   permeability
(E)
             (D)   resistance
***
−   (E)   saturation
***

13   A magnetic material brought near a permanent
             magnet becomes a temporary magnet.   This
S17A   phenomenon is called magnetic
III.3.b
             (A)   conduction
S 200
             (B)   induction
A2
A7   (C)   permeability

(B)   (D)   production

**   (E)   saturation
−
**

1

S17A
III.3.a

198

A3
A2

(B)

*
−
*

When a bar magnet is broken into two pieces, the result is one magnet having only a north pole and another magnet having only a south pole.

(A)   True

(B)   False

2

S17A
III.3.a

198

A3
A2

(A)

*
−
**

When a bar magnet is broken into two pieces, the result is two smaller magnets each having a north and a south pole.

(A)   True

(B)   False

3

S17A
III.3.c

S 200

A2

(A)

The space surrounding a magnet in which its magnetic influence can be detected is called a magnetic field.

(A)   True

(B)   False

4

S17A
III.3.c

S 200

A2

(B)

The space surrounding a magnet in which its magnetic influence can be detected is called a magnetic conductor.

(A)   True

(B)   False

ELECTROMAGNETS

1

S17A
III.3.c

203

A4

(A)

***
-
***

A single straight conductor carries
electrons out of the plane of the
paper toward you as shown.

What direction and shape are the
magnetic field lines?

(A)   clockwise concentric circles around the
      conductor

(B)   counter-clockwise concentric circles around
      the conductor

(C)   straight lines radiating outward from the
      conductor

(D)   straight lines radiating inward toward the
      conductor

(E)   straight lines directed from left to right
      on the page

2

S17A
III.3.c

203

A8
A4

(A)

***
-
***

The diagram shows a wire in
which there is a large electron
flow from west to east. If a
magnetic compass is held under
and close to the wire, the N
pole of the compass needle
will point
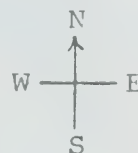
(A)   south

(B)   north

(C)   east

(D)   west

(E)   north east
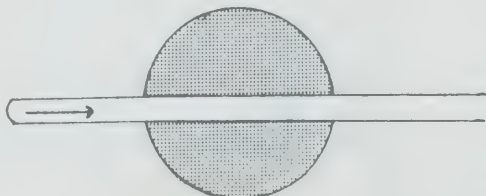
3

S17A
III.3.c

203

A8

(D)

***
-
***

A segment of a copper conductor is shown in the
diagram.   A compass is placed to the east of the
conductor as shown.   When electrons flow through
the conductor, the N pole of the compass needle is
deflected to point south.

| Copper Conductor | Compass | N |
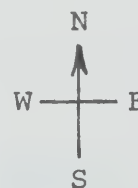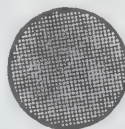
The direction of the electron flow in the conductor
is

(A)   east

(B)   south

(C)   west

(D)   out of the plane of the page

(E)   into the plane of the page

4

S17A
III.3.c

S 203

A8

(A)

***
-
***

A particle emitted by a radioactive substance is
travelling horizontally from south to north.   It
is deflected to the east by a magnetic field that
is directed vertically downward into the plane of
the page.   One can therefore conclude that the
particle

(A)   is negatively charged

(B)   is positively charged

(C)   has no charge on it

(D)   is a gamma ray

(E)   is the product of a fission reaction

5

S17A
III.3.d

205

A1
A8

(A)

***

–
***
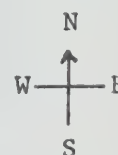
If other factors remain constant, which of the
following combinations of electric current and
the number of turns in the coil produces the
strongest electromagnet?

(A)   500 turns and 3 A

(B)   700 turns and 2 A

(C)   300 turns and 4 A

(D)   200 turns and 5 A

(E)   100 turns and 10 A

6

S17A
III.3.d

S 205

A1

(D)

**
–
***

The temporary magnets used in electromagnets are
usually made of

(A)   alnico

(B)   aluminum

(C)   copper

(D)   soft iron

(E)   hardened steel

7

S17A
III.3.b

S 205

A1

(D)

**
–
**

Which of the following substances has the highest
magnetic permeability?

(A)   aluminum

(B)   copper

(C)   glass

(D)   iron

(E)   wood

8

S17A
III.3.e

S 205

A1

(E)

**

—

**

Soft iron is used in the cores of lifting electro-
magnets rather than copper because iron

(A) withstands a higher temperature

(B) has a greater resistance

(C) makes a better permanent magnet

(D) is a better insulator

(E) has a higher magnetic permeability

9

S17A
III.3.f

206

A8
A4

(A)

***

—

***

The diagram illustrates a straight wire conductor
situated between the poles of a permanent magnet.
The poles of the magnet are in the plane of the
page, and the wire is perpendicular to the plane
of the page. The wire is carrying an electron
flow away from you into the plane of the page as
indicated by the cross.

The direction of the magnetic force on the wire is

(A) ↑

(B) ↓   N ⊗ S

(C) ⟵

(D) ⟶

(E) the same as the electron flow

10

A moving coil galvanometer is changed into an ammeter by the addition of a

S17A
III.3.h

(A)   high resistance in series with the coil

S 206

(B)   low resistance in series with the coil

A2
A1

(C)   high resistance in parallel with the coil

(D)

(D)   low resistance in parallel with the coil

***
-
***

(E)   shunt in series with the coil

11

A voltmeter is a galvanometer connected

S17A
III.3.h

(A)   in parallel with a high resistance

S 206

(B)   in parallel with a low resistance

A2
A7

(C)   in series with a high resistance

(D)   in series with a low resistance

(C)

(E)   in series with a shunt

***
-
***

12

If M represents the change in magnetic field strength surrounding a conductor, which one of the following rates of change produces the greatest induced voltage?

S17A
III.3.i

(A)   0.25 M in 0.5 s

207

(B)   0.5 M in 0.25 s

F1
A8

(C)   1 M in 1 s

(B)

(D)   3 M in 4 s

***
-
***

(E)   100 M in 100 s

1

S17A
III.3.c

203

A8
A4

(A)

**

-

**

The electron flow in a wire is out of the plane of the page toward you as shown in the diagram below.

wire   magnetic field
⊙
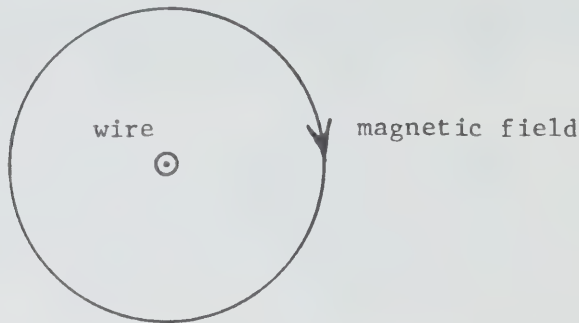
The direction of the magnetic field about the wire is indicated correctly by the arrow.

(A)   True

(B)   False

2

S17A
III.3.c

204

F1
A8
A4

(B)

***

-

***

Consider the following circuit diagram.

Coil

Compass

+   -

D.C. Source   S
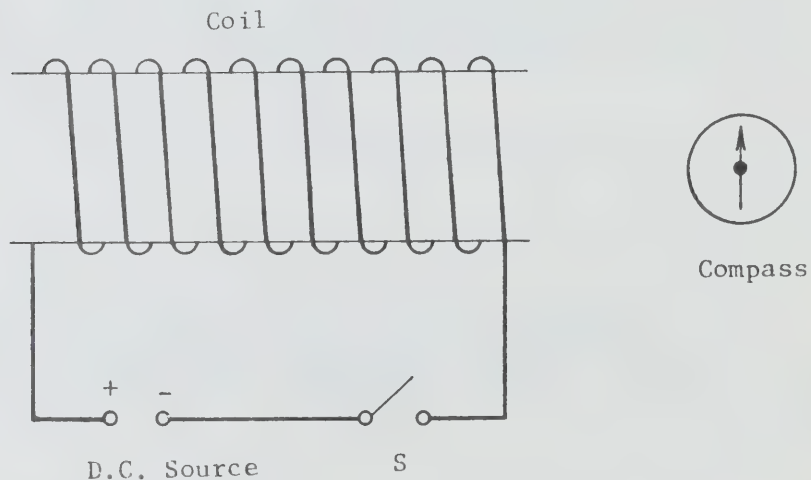
When the switch S is closed, the N pole of the compass needle will point to the left.

(A)   True

(B)   False

3

S17A
III.3.c

204

A8
A4

(B)

**

—

***

If electrons flow in the direction indicated by the
arrows in the diagram below, end X will be a N pole.
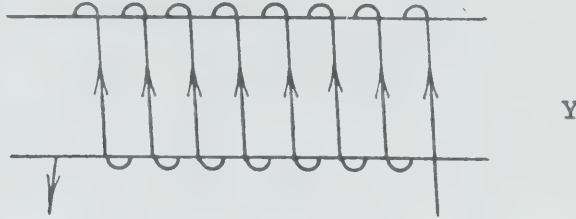
(A)   True

(B)   False

4

S17A
III.3.f

206

A8
A4
A2

(A)

**

—

**

The following diagram represents a permanent magnet
and a wire carrying a current.
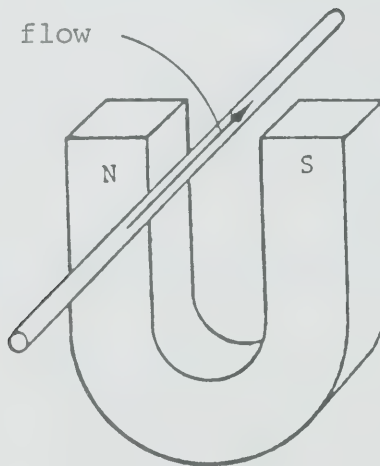
Reversing the direction of the electron flow, while
maintaining the polarity of the magnet, will reverse
the direction of the electromagnetic force on the
wire.

(A)   True

(B)   False

5

S17A
III.3.f

206

A8
A4
A2

(A)

**

-

**

The following diagram represents a permanent magnet
and a wire carrying a current.

electron flow

N   S
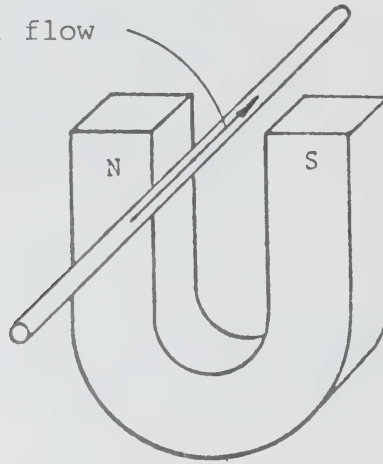
If the North and South poles of the magnet are
interchanged, while the direction of the electron
flow is left as shown, the direction of the electro-
magnetic force on the wire will be reversed.

(A)   True

(B)   False

6

S17A
III.3.f

206

A8
A4
A2

(B)

***
‒
***

The following diagram represents a permanent magnet and a wire carrying a current.

electron flow

N   S
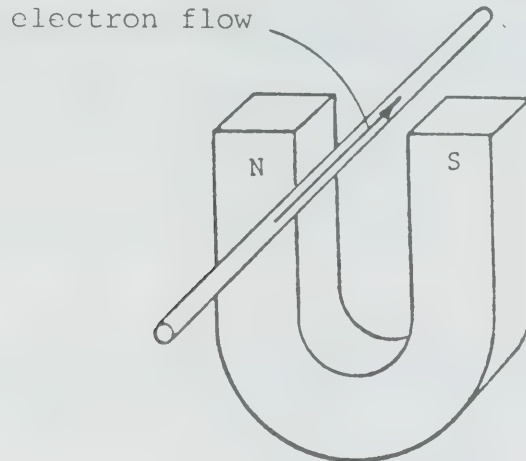
Reversing both the polarity of the magnet and the direction of the electron flow will reverse the direction of the electromagnetic force on the wire.

(A)   True

(B)   False

7

S17A
III.3.i

207

A8
A2

(B)

***
‒
***

A bar magnet at rest near a coil of wire induces a current in the coil.

(A)   True

(B)   False

APPLICATIONS

1

S17A
III.3.n

210

A1

(B)

***
-
***

The electric current from a simple D.C. generator driven at constant speed has constant

(A)   magnitude only

(B)   direction only

(C)   magnitude and direction only

(D)   magnitude, direction and frequency

(E)   magnitude, direction and voltage

2

S17A
III.3.n

210

A1

(A)

A D.C. generator is turned at a constant rate. The resulting electric current will vary

(A)   in magnitude only

(B)   in direction only

(C)   in frequency only

(D)   in magnitude and direction

(E)   in magnitude and frequency

3   A step-down transformer is used to change

S17A   (A)   high power to low power
III.3.p
              (B)   direct current to alternating current
S 214
              (C)   alternating current to direct current
A1
A2   (D)   high voltage to low voltage

(D)   (E)   low voltage to high voltage

**
–
**

4   This question involves two statements:

S17A   I.   An electric current can be increased
III.3.p   by means of a step-up transformer.

216   II.   In a step-up transformer the output
                            power is greater than the input power.
A8
A2   Which of the following responses correctly describes
              the two statements?
(E)
              (A)   Both statements are true and one statement can
***   be used to explain the other.
–
***   (B)   Both statements are true, but neither statement
                    can be used to explain the other.

              (C)   Statement I is true.
                    Statement II is false.

              (D)   Statement I is false.
                    Statement II is true.

              (E)   Statement I is false.
                    Statement II is false.

5

S17A
III.3.p

217

B4
F1

(B)

***
--
***

A transformer used with a certain model train set
has 240 turns in its primary coil and 12 turns in
its secondary coil. The transformer is connected
to a 120 V wall receptacle.

The most precise reading of the transformer's
output will be given by a voltmeter with a range of

(A)   0 to 10 V D.C.

(B)   0 to 10 V A.C.

(C)   0 to 25 V D.C.

(D)   0 to 25 V A.C.

(E)   0 to 150 V A.C.

6

S17A
III.3.p

217

F1
A8

(A)

***
--
***

A 100% efficient transformer has 500 turns in the
primary coil and 6 000 turns in the secondary coil.
If a current of 8.0 A flows in the primary coil,
what current flows in the secondary coil?

(A)   0.67 A

(B)   1.5 A

(C)   6.7 A

(D)   96 A

(E) 9.6×10^2 A

7

S17A
III.3.p

217

F1
A8

(A)

**
--
***

A generator supplies 100 V to the primary coil of
a transformer with 50 turns. If the secondary coil
has 500 turns, then the secondary voltage is

(A) 1.0×10^3 V

(B) 5.0×10^2 V

(C) 2.5×10^2 V

(D) 1.0×10^2 V

(E) 1.0×10^1 V

8

S17A
III.3.p

217

F1
A8

(D)

***
-
***

A transformer with 500 turns in the primary coil and 6000 turns in the secondary coil is connected to a source with an electrical potential of 120 V A.C.

What is the electrical potential of the secondary coil?

(A)   10.0 V

(B)   12.0 V

(C)   144 V

(D) 1.44×10^3 V

(E) 2.50×10^3 V

9

S17A
III.2.c

218

F1
A2

(D)

**
-
***

AC electricity is supplied at 60 Hz. The electrons in the conducting wires make one complete vibration in

(A)   1 s

(B)   60 s

(C) $\frac{1}{30}$ s

(D) $\frac{1}{60}$ s

(E) $\frac{1}{120}$ s

1   The product of current and potential difference for
            the secondary coil of an ideal transformer is the
S17A   same as for the primary coil.
III.3.p
                (A)   True
216
                (B)   False
A1
A8

(A)

***
-
***

2   A potential difference is induced in the secondary
            coil of a transformer if a changing current flows
S17A   in the primary coil.
III.3.p
                (A)   True
216
                (B)   False
A8
A2

(A)

**
-
**

3   A voltage is induced in the secondary coil of
            a transformer if the primary coil carries an
S17A   alternating current.
III.3.p
                (A)   True
216
                (B)   False
A8
A2

(A)

**
-
**

4   If the primary coil of a transformer carries a
                fluctuating direct current, no voltage is induced
S17A   in the secondary coil.
III.3.p
                (A)   True
216
                (B)   False
A8
A2

(B)

**

—

***

BASIC ELECTRONICS

THE **p-n** JUNCTION

1

S17A
III.2.f

221

A1
A2

(D)

**

-

***

A conductor is a solid in which

(A)   protons move freely from one atom to another

(B)   neutrons move freely from one atom to another

(C)   protons and neutrons move freely from one atom
      to another

(D)   electrons move freely from one atom to another

(E)   electrons and neutrons move freely from one
      atom to another

2

S17A
III.2.f

221

A1
A2

(E)

***

-

***

Which of the following materials is the best
conductor of electricity at room temperature?

(A)   aluminum

(B)   copper

(C)   iron

(D)   rubber

(E)   silver

3   Why is copper a better conductor of electricity
           than iron?

S17A
III.2.f   (A)   Copper is more dense than iron.

221   (B)   Copper atoms are closer together than iron atoms.

A2   (C)   Electrons move more freely in copper than in
A1   iron.

(C)   (D)   Copper contains more free protons than iron.

***   (E)   Copper is a better conductor of heat than iron.
-
***

4   Which of the following substances is the best
           conductor of electricity at room temperature?

S17A
III.2.f   (A)   aluminum

S 221   (B)   plastic

A1   (C)   pure water
A2
           (D)   copper
(D)
           (E)   wax
**
-
**

5   A solid electrical conductor is a substance in which

S17A   (A)   electrons are free to move
III.2.f
           (B)   positive ions are free to move
S 221
           (C)   electron pairs are shared by adjacent atoms
A2
           (D)   there is a positive ion vibration due to the
(A)   electric force

**   (E)   the ions and electrons are tightly bound,
-                thereby forming a metal
***

RAY

OR

GEOMETRIC OPTICS

SOURCES AND TRAVEL

1

S17A
II.3.a
S17C
II.1.a

253

A2

(D)

**
-
**

A white ceiling aids in the illumination of a room because of

(A) absorption

(B) dispersion

(C) emission

(D) reflection

(E) refraction

2

S17A
II.3.a
S17C
II.1.a

253

A2

(D)

**
-
**

This page is visible because it

(A) is incandescent

(B) emits light

(C) refracts light

(D) reflects light

(E) absorbs light

3   A luminous body is one that

S17A   (A)   emits light
II.3.a
S17C   (B)   reflects light
II.1.a
                (C)   either emits or reflects light
S 253
                (D)   is transparent to light
A2
                (E)   reflects or absorbs light
(A)

***
—
***

4   Substances that do not transmit light at all are
               said to be
S17A
II.3.a   (A)   transparent
S17C
II.1.a   (B)   translucent

255   (C)   opaque

A1   (D)   diffuse

(C)   (E)   incandescent

**
—
**

5   A piece of frosted glass is

S17A   (A)   incandescent
II.3.a
S17C   (B)   luminous
II.1.a
                (C)   opaque
255
                (D)   translucent
A2
                (E)   transparent
(D)

**
—
**

6

S17A
II.3.a
S17C
II.1.a

255

A2

(E)

**
−
**

The lens of an ordinary camera is

(A)   incandescent

(B)   luminous

(C)   opaque

(D)   translucent

(E)   transparent

7

S17A
II.3.a
S17C
II.1.a

255

A2

(B)

**
−
**

A substance through which no light can pass is said to be

(A)   non-luminous

(B)   opaque

(C)   solid

(D)   translucent

(E)   coloured

1   The moon is an example of a luminous object.

S17A   (A)   True
II.3.a
S17C   (B)   False
II.1.a

253

A2
A1

(B)

***
--
***

REFLECTION

1

S17A
II.3.a
S17C
II.1.a

263

F1
A8

(D)

***
-
***

A ray of light is incident on a reflecting surface as shown in the diagram.

How large is the angle of reflection?

(A)   150°

(B)   120°

(C)   90°

(D)   60°

(E)   30°

2

S17A
II.3.a
S17C
II.1.a

263

F1
A8

(D)

**
-
***
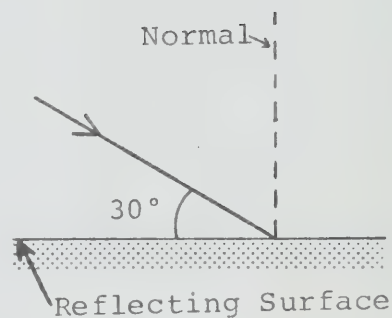
An incident light ray strikes a plane mirror at an angle of 45°. The angle between the incident and reflected light rays is

(A)   22.5°

(B)   45°

(C)   67.5°

(D)   90°

(E)   135°

3

S17A
II.3.a
S17C
II.1.a

S 263

F1
A8

(B)

***
-
***

An incident ray of light is initially normal to the surface of a plane mirror. The mirror is rotated until the angle between the incident and reflected rays is 30°. The mirror has been rotated through an angle of

(A)   7.5°

(B)   15°

(C)   30°

(D)   45°

(E)   60°

4

S17A
II.3.a
S17C
II.1.a

264

F1
A1

(E)

**
-
**

An object 12 cm tall is placed 4 m directly in front of a vertical plane mirror. The image is

(A)   on the surface of the mirror

(B)   4 m directly in front of the mirror

(C)   directly above the mirror

(D)   directly below the mirror

(E)   4 m directly behind the mirror

5

S17A
II.3.a
S17C
II.1.a

264

F1
A1

(D)

**
-
***

An object 12 cm tall is placed 4 m in front of a vertical plane mirror. What is the distance from the object to the image?

(A)   2 m

(B)   4 m

(C)   6 m

(D)   8 m

(E)   16 m

6

S17A
II.3.a
S17C
II.1.a

264

F1
A1

(C)

***
–
***

A model is standing in front of a plane mirror. The
distance from the model to the image is 4.0 m. How
far is the model from the reflecting surface?

(A)   8.0 m

(B)   4.0 m

(C)   2.0 m

(D)   0

(E)   Impossible to determine from the information
given.

7

S17A
II.3.a
S17C
II.1.a

264

F1
A1

(A)

***
–
**

X and Y are each 2.0 m tall. X stands 4.0 m from
a vertical plane mirror, and Y stands slightly to
one side of X and 8.0 m from the same mirror.

What is the approximate distance between X's image
and Y's image?

(A)   4.0 m

(B)   8.0 m

(C)   12 m

(D)   16 m

(E)   Insufficient data is given to determine the
distance.

8

S17A
II.3.a
S17C
II.1.a

265

A1

(C)

***
–
***

X and Y are each 2 m tall. X stands 4 m from a
vertical plane mirror and Y stands slightly to
one side of X and 8 m from the same mirror. The
size of X's image compared with Y's image is

(A)   four times as great

(B)   twice as great

(C)   the same size

(D)   half as great

(E)   one quarter as great

9

S17A
II.3.a
S17C
II.1.a

265

A1

(D)

An object 12 cm tall is placed 4 m in front of a vertical plane mirror. The image is

(A)   real, inverted and smaller.

(B)   real, erect and the same size.

(C)   virtual, inverted and the same size.

(D)   virtual, erect and the same size.

(E)   virtual, erect and larger.

***
-
***

10

S17A
II.3.a
S17C
II.1.a

265

A2
A1

(D)

When you stand 6 m from a full length mirror, your image is

(A)   real and 3 m behind the mirror

(B)   real and 6 m behind the mirror

(C)   virtual and 3 m behind the mirror

(D)   virtual and 6 m behind the mirror

(E)   virtual and at the surface of the mirror

***
-
***

11

S17A
II.3.a
S17C
II.1.a

S 265

F1
A1

(B)

An object 12 cm tall is placed 4.0 m in front of a vertical plane mirror which has a height of 24 cm. The height of the image is

(A)   6.0 cm

(B)   12 cm

(C)   18 cm

(D)   24 cm

(E)   4.0 m

***
-
***

12

S17A
II.3.a
S17C
II.1.a

266

F1
A8

(B)

***
—
***

Consider the following diagram of a boy looking at his image in a mirror from position I. Assume that the mirror has unlimited width.
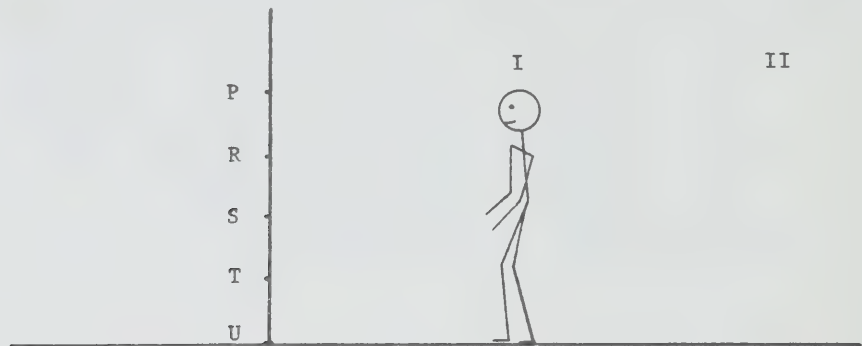
If the boy moves back to position II, what is the minimum length <u>and</u> position of the mirror required so that he can <u>see</u> his complete image?

(A)   PR

(B)   PS

(C)   PT

(D)   PU

(E)   RT

13

S17A
II.3.a
S17C
II.1.a

S 272

A1
A2

(B)

***
—
***

A ray of light travels parallel to the principal axis of a spherical concave mirror. After reflection, the ray passes

(A)   back along its original path

(B)   through the principal focus

(C)   through the centre of curvature

(D)   through the vertex

(E)   through the point midway between the vertex and the principal focus

14

S17A
II.3.a
S17C
II.1.a

266

F1
A8

(B)

***
-
***

Consider the following diagram of a boy looking at his image in a mirror. Assume that the mirror has unlimited width.
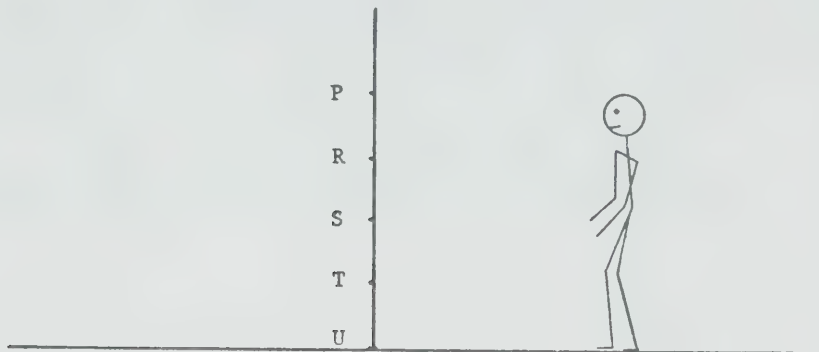
What is the minimum length and position of the mirror required so that the boy can see his complete image?

(A) PR

(B) PS

(C) RT

(D) SU

(E) PU

15

S17A
II.3.a
S17C
II.1.a

S 274

A2
A1

(D)

***
-
***

A point source is to be used with a concave mirror to produce a beam of parallel light. Where should the point source be placed?

(A) as close to the mirror as the light source will permit

(B) at the centre of curvature of the mirror

(C) halfway between the centre of curvature and principal focus of the mirror

(D) at the point halfway between the centre of curvature and the mirror

(E) at the point halfway between the principal focus and the mirror

16   The term virtual, as used to describe an image,
            means that the image

S17A
II.3.a   (A)   is located on the surface of the mirror
S17C
II.1.a   (B)   cannot be photographed by a camera

275   (C)   is located in front of the mirror

A2   (D)   is the same size as the object

(E)   (E)   cannot be caught directly by a screen

***
-
***

17   The image produced by a convex mirror is

S17A   (A)   always real, smaller than the object, and
II.3.a   upright
S17C
II.1.a   (B)   always virtual, larger than the object, and
                  upright
275
            (C)   always real, larger than the object, and
A2   upright
A1
            (D)   always virtual, smaller than the object, and
(D)   upright

***   (E)   any of the above, depending on the separation
-                 of the object and mirror
***

18   An object is 2 m in front of a plane mirror. The
            image is

S17A
II.3.a   (A)   virtual, inverted, and 2 m behind the mirror.
S17C
II.1.a   (B)   virtual, inverted and 2 m in front of the mirror.

275   (C)   virtual, erect, and 2 m in front of the mirror.

F1   (D)   real, erect, and 2 m behind the mirror.
A1
            (E)   none of the above.
(E)

***
-
***

19

S17A
II.3.a
S17C
II.1.a

275

F1
A1
A2

(B)

**

-

**

A student stands in front of a plane mirror hung vertically. The initials and periods D.E. are printed on his T-shirt. He sees the image of these initials and periods as

(A)   D.E.

(B)   .Ǝ.ᗡ

(C)   ˙Ǝ˙ᗡ

(D)   Ǝ˙ᗡ

(E)   ˙Ǝ˙ᗡ

20

S17A
II.3.a
S17C
II.1.a

275

F1
A2

(A)

***

-

***

A convex spherical mirror has a focal length equal to 12 cm. If an object is placed 24 cm in front of the mirror, the position of its image is

(A)   8.0 cm behind the mirror

(B)   8.0 cm in front of the mirror

(C)   24 cm behind the mirror

(D)   24 cm in front of the mirror

(E)   36 cm behind the mirror

21

S17A
II.3.a
S17C
II.1.a

S 275

A1

(E)

**

-

**

Plane, concave and convex mirrors all produce virtual images. Compared to the size of the object, virtual images are

(A)   always smaller for all mirrors.

(B)   always the same size for all mirrors.

(C)   always larger for all mirrors.

(D)   only smaller or larger depending on the mirror.

(E)   smaller, the same size, or larger depending on the mirror.

2 2

S17A
II.3.a
S17C
II.1.a

275

F1
A2

(B)

***
—
***

A convex spherical mirror has a focal length equal
to 12 cm. If an object is placed 24 cm in front
of the mirror, the distance of its image from the
mirror is

(A)   2.0 cm

(B)   8.0 cm

(C)   24 cm

(D)   36 cm

(E)   infinite

2 3

S17A
II.3.a
S17C
II.1.a

S 275

A1
A2

(A)

***
—
***

A double convex lens, whose focal length is 8.0 cm,
has an object standing 4.0 cm outside the focal point.
The image formed is 12 cm high. The characteristics
of the image formed are

(A)   real, inverted and larger

(B)   real, upright and larger

(C)   virtual, upright and smaller

(D)   virtual, upright and larger

(E)   real, inverted and smaller

2 4

S17A
II.3.a
S17C
II.1.a

S 275

A1
A2

(D)

***
—
***

An object stands at a distance greater than the
focal length from a convex mirror. The character-
istics of the image are

(A)   real, inverted and smaller

(B)   virtual, inverted and larger

(C)   real, inverted and larger

(D)   virtual, upright and smaller

(E)   real, upright and larger

25

S17A
II.3.a
S17C
II.1.a

S 275

A1
A2

(C)

An object is located between a concave mirror and the principal focus. Its image is

(A)   real, erect and larger.

(B)   real, inverted and larger.

(C)   virtual, erect and larger.

(D)   virtual, inverted and larger.

(E)   virtual, erect and smaller.

***
−
***

26

S17A
II.3.a
S17C
II.1.a

S 275

A1
A2

(B)

The focal length of a concave mirror is 10 cm. If an object is placed 20 cm from the mirror, the image will be

(A)   real and larger

(B)   real and the same size

(C)   virtual and larger

(D)   virtual and the same size

(E)   virtual and smaller

***
−
***

27

S17A
II.3.a
S17C
II.1.a

S 275

F1
A1

(B)

A concave mirror has a focal length of 10 cm. Where should the object be placed so that the rays which are reflected from the mirror are parallel and form no image?

(A)   8.0 cm in front of the mirror

(B)   at the principal focus

(C)   12 cm in front of the mirror

(D)   at an infinite distance from the mirror

(E)   none of the above

***
−
***

28

S17A
II.3.a
S17C
II.1.a

S 275

F1
A1

(E)

***
-
***

A concave mirror has a focal length of 10 cm.
Where should the object be placed to produce an
image which is virtual, upright, and smaller than
the object?

(A)   8.0 cm in front of the mirror

(B)   at the principal focus

(C)   12 cm in front of the mirror

(D)   20 cm in front of the mirror

(E)   None of the above. This image cannot be
       produced with a concave mirror.

29

S17A
II.3.a
S17C
II.1.a

S 275

F1
A1

(C)

***
-
***

A concave mirror has a focal length of 10 cm.
Where should an object be placed to produce an
image which is real, inverted and larger than
the object?

(A)   8.0 cm in front of the mirror

(B)   at the principal focus

(C)   12 cm in front of the mirror

(D)   an infinite distance from the mirror

(E)   none of the above

30

S17A
II.3.a
S17C
II.1.a

S 275

F1
A1

(C)

***
-
***

A concave mirror with a focal length of 6.0 cm has
a 4.0 cm high object standing 8.0 cm from the mirror.
What is the height of the image?

(A)   2.5 cm

(B)   8.0 cm

(C)   12 cm

(D)   16 cm

(E)   18 cm

31

The centre of curvature C of a concave mirror is 20 cm from the vertex V.

Where in front of the mirror should the object be placed to produce an image which is real, inverted, and larger than the object?

(A) 5.0 cm from the vertex

(B) 10 cm from the vertex

(C) 15 cm from the vertex

(D) 20 cm from the vertex

(E) 25 cm from the vertex
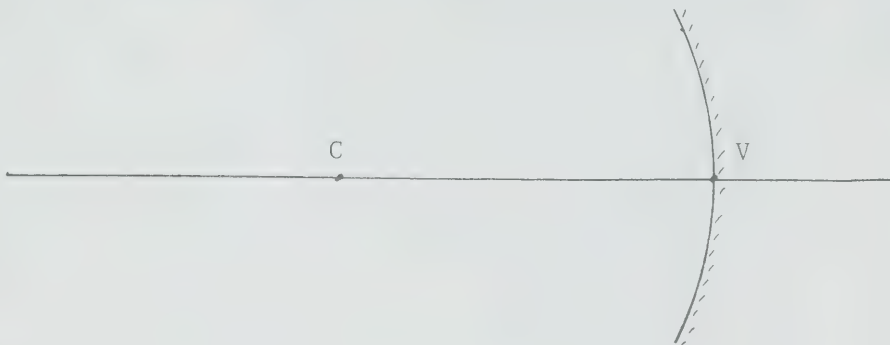
32

A concave mirror with a focal length of 6.0 cm has a 4.0 cm high object standing 8.0 cm from the mirror. Where is the image located?

(A) 4.0 cm from the focal point

(B) 6.0 cm from the focal point

(C) 8.0 cm from the focal point

(D) 9.0 cm from the focal point

(E) 18 cm from the focal point

33

S17A
II.3.a

S 275

F1
A8

(B)

***
-
***

Where must an object be placed in front of a concave mirror so that the image formed will have the same height as the object?

(A)   at the principal focus

(B)   at the centre of curvature

(C)   between the principal focus and the mirror

(D)   between the principal focus and the centre of curvature

(E)   outside the centre of curvature

34

S17A
II.3.c

S 276

A7

(A)

**
-
***

A student wishes to determine the factors which affect the quality of the image produced on a screen.   Which of the following is not acceptable scientific practice?

(A)   Formulate a conclusion based on what the factors are predicted to be.

(B)   Write a mathematical equation relating the empirical factors and then solve it.

(C)   Look up the subject of image production in the library.

(D)   Design an experiment where the influence of one factor at a time can be determined.

(E)   Investigate many images using various pieces of apparatus and compare the data obtained.

1

S17A
II.3.a
S17C
II.1.a

262

A2

(A)

*
-
**

In the study of light, a normal is a reference line
drawn perpendicular to a surface at the point where
light strikes the surface.

(A)   True

(B)   False

2

S17A
II.3.a

262

A2

(B)

**
-
***

When light is reflected from a plane surface, the
normal to that surface is perpendicular to the
incident ray.

(A)   True

(B)   False

3

S17A
II.3.a
S17C
II.1.a

263

A8
A2

(B)

**
-
**

When light is reflected, the angle between the
incident ray and the normal is always larger than
the angle between the reflected ray and the normal.

(A)   True

(B)   False

4

S17A
II.3.a
S17C
II.1.a

263

A8
A2

(B)

**
\-
***

The angle between the incident ray and the normal is always equal to the angle between the incident ray and the reflecting surface.

(A)   True

(B)   False

5

S17A
II.3.a

264

A2
A1

(A)

**
\-
**

A person standing 2 m from a plane mirror will be 4 m from his image.

(A)   True

(B)   False

6

S17A
II.3.a

269

A1
A2

(B)

***
\-
***

Light rays travelling parallel to the principal axis of a convex mirror will converge after reflection.

(A)   True

(B)   False

7

S17A
II.3.a

270

A2
A1

(B)

***
–
***

A ray of light travelling parallel to the principal
axis is incident on a convex spherical mirror. The
reflected ray will then travel through the principal
focus.

(A)   True

(B)   False

8

S17A
II.3.a

274

A1
A2

(B)

***
–
***

An object located at the principal focus of a concave
mirror produces an image at a distance of one focal
length from the mirror.

(A)   True

(B)   False

9

S17A
II.3.a

275

A1
A2

(A)

**
–
***

A convex mirror cannot produce a real image of a
real object.

(A)   True

(B)   False

10

S17A
II.3.a

275

A1
A2

(B)

***
--
***

The image formed by a concave spherical mirror is virtual if the object is placed between the principal focus and the centre of curvature of the mirror.

(A)   True

(B)   False

11

S17A
II.3.a

275

A1
A2

(A)

**
--
**

A spherical concave mirror will produce a real image of a candle when the candle is placed between the centre of curvature and the principal focus.

(A)   True

(B)   False

12

S17A
II.3.a

275

A1
A2

(A)

***
--
***

The image formed by a concave spherical mirror is the same size as the object if the object is at the centre of curvature of the mirror.

(A)   True

(B)   False

13

S17A
II.3.a

275

A1
A2

(A)

**
–
**

A concave spherical mirror will produce an image
larger than the object if the object is placed
between the principal focus and the mirror.

(A)   True

(B)   False

14

S17A
II.3.a

275

A2
A1

(A)

**
–
**

A concave spherical mirror can produce an enlarged,
real, inverted image of an object.

(A)   True

(B)   False

15

S17A
II.3.a

275

A2
A1

(B)

***
–
***

A concave spherical mirror can produce a virtual,
erect image that is smaller than the object.

(A)   True

(B)   False

16   The type of image (real or virtual) formed by a
             convex mirror depends on the position of the object
S17A   relative to the mirror.
II.3.a
             (A)   True
275
             (B)   False
A3
A2

(B)

***
—
***

17   Shaving mirrors which produce magnified images are
             concave mirrors.
S17A
II.3.a   (A)   True

277   (B)   False

A2
A1

(A)

**
—
**

18   The mirrors used in stores to discourage shop-
             lifting are concave mirrors.
S17A
II.3.a   (A)   True

277   (B)   False

A2
A1

(B)

**
—
**

19   Concave mirrors are used on trucks to enlarge the
             field of view.
S17A
II.3.a   (A)   True

277   (B)   False

A2
A1

(B)

**
−
**

20   Convex mirrors are used on trucks to enlarge the
             field of view.
S17A
II.3.a   (A)   True

277   (B)   False

A2
A1

(A)

*
−
*

REFRACTION

1

S17A
II.3.a
S17C
II.1.a

278

A2
A11
D3

(C)

**

-

***

The path of a light ray travelling from air to glass is shown below.
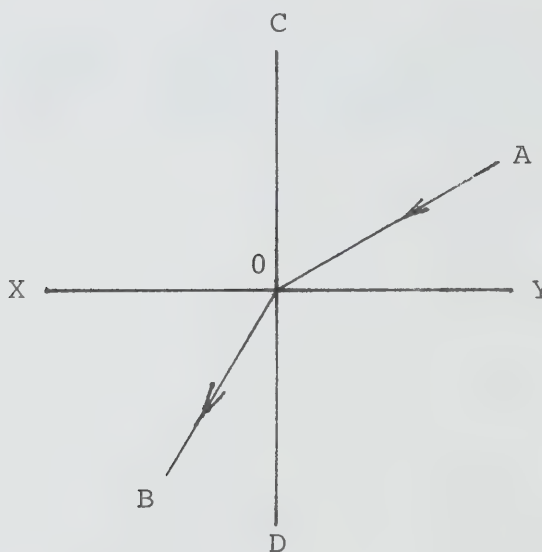
The line CD represents the

(A) incident ray

(B) interface between air and glass

(C) normal

(D) reflected ray

(E) refracted ray

2

S17A
II.3.a
S17C
II.1.a

278

A2
A11
D3

(B)

***
-
***

The path of a light ray travelling from air to glass is shown below.
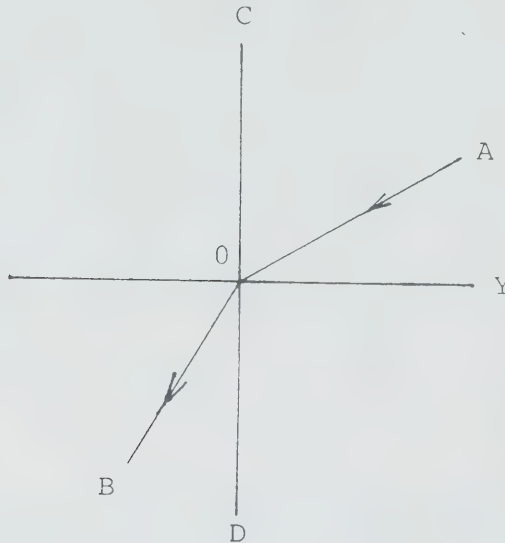
The angle of incidence is

(A)   AOY

(B)   AOC

(C)   BOX

(D)   BOD

(E)   COX

3

S17A
II.3.a
S17C
II.1.b

278

A2
F1

(A)

***
-
***

Light travels from air into water. The light ray in water makes an angle of 90° with the water surface. The angle of incidence

(A)   is 0°

(B)   is 42°

(C)   is 90°

(D)   is greater than the critical angle

(E)   cannot be determined

4

S17A
II.3.a
S17C
II.1.a

278

A2
A11
D3

(B)

***
—
***

The path of a light ray travelling from air to glass is shown below.
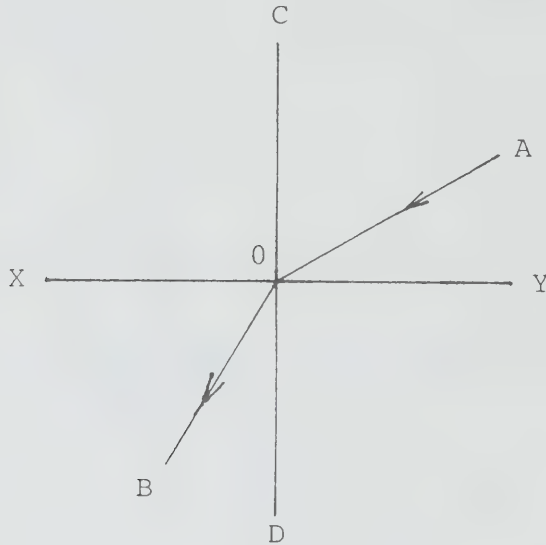
The angle of refraction is

(A)   AOY

(B)   BOD

(C)   AOC

(D)   BOX

(E)   COX

5

S17A
II.3.a
S17C
II.1.b

283

A2

(D)

**
—
***

If a ray of light changes its direction when passing from one substance to another we say it is

(A)   reflected

(B)   diffracted

(C)   dispersed

(D)   refracted

(E)   diffused

6

S17A
II.3.a
S17C
II.1.b

283

A8

(B)

***
—
***

When a ray of light passes obliquely from air into water, it

(A) bends away from the normal

(B) bends toward the normal

(C) takes the direction of the normal

(D) does not change direction

(E) all reflects back into air

7

S17A
II.3.a
S17C
II.1.b

283

F1
A11

(D)

***
—
***

A ray of light passes through two different transparent materials (I and II in the diagram) as shown. The faces of the materials are plane and parallel.
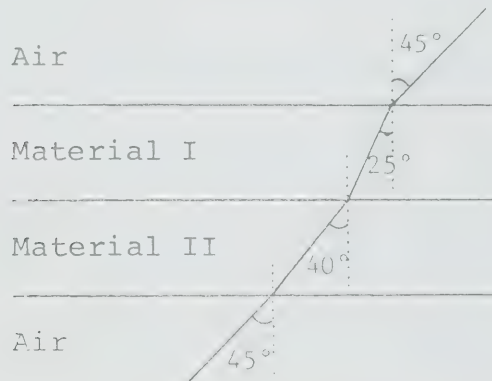
The refractive index of material I is

(A) less than that of air and less than that of material II

(B) greater than that of air and less than that of material II

(C) less than that of air and greater than that of material II

(D) greater than that of air and greater than that of material II

(E) the same as that of air and that of material II

8

Total reflection of light occurs at the surface between air and glass when

S17A
II.3.a   (A)   the light is travelling from air toward glass
S17C
II.1.b   (B)   the angle of incidence is greater than the
                    critical angle
286
              (C)   the angle of incidence is less than the
A1   critical angle
A5
              (D)   the angle of incidence is zero
(B)
              (E)   the angle of incidence equals the angle of
***   refraction
-
***

9

The critical angle for diamond is 25°. Total internal reflection occurs when light is incident on

S17A
II.3.a   (A)   the air to diamond boundary at an angle of
S17C   incidence of 25°
II.1.b
              (B)   the air to diamond boundary at an angle of
286   incidence greater than 25°

A10   (C)   the air to diamond boundary at an angle of
A2   incidence less than 25°

(E)   (D)   the diamond to air boundary at an angle of
                    incidence less than 25°
***
-             (E)   the diamond to air boundary at an angle of
***   incidence greater than 25°

1 0

The critical angle for water is 49°. Light travel-
ling initially in the water strikes the surface at
S17A   an incidence angle of 30°. After striking the
II.3.a   water-air boundary, the light
S17C
II.1.b   (A)   is partly reflected and partly refracted

286   (B)   is totally refracted

A10   (C)   is totally reflected
A2
              (D)   travels along the boundary
(A)
              (E)   travels along the normal
**
-
***

11

S17A
II.3.a
S17C
II.1.a

S 291

A1

(D)

***
–
***

When a light ray passes obliquely through a trans-
parent medium with parallel surfaces, the emergent
ray

(A) is totally internally reflected `

(B) is bent more toward the normal than the
      incident ray

(C) is bent further away from the normal than the
      incident ray

(D) is parallel to the incident ray, but displaced
      sideways

(E) continues in a straight line from the incident
      ray

12

S17A
II.3.a
S17C
II.1.c

292

A1

(B)

***
–
***

Which of the following colours of light is refracted
the least by a glass prism?

(A) orange

(B) red

(C) violet

(D) yellow

(E) white

13

S17A
II.3.a
S17C
II.1.c

292

A1

(B)

***
–
***

Which of the following components is deviated most
when white light is passed through a triangular glass
prism?

(A) red

(B) violet

(C) yellow

(D) green

(E) blue

14

S17A
II.1.b
S17C
II.1.b

S 295

A2
A7

(B)

**

—

***

A child uses a convex (converging) lens of focal
length 6.0 cm to focus the sun's rays on a piece of
paper. The paper is most likely to burn if its
distance from the lens is

(A)   3.0 cm

(B)   6.0 cm

(C)   9.0 cm

(D)   12 cm

(E)   very large

15

S17A
II.3.b

297

F1
A5

(E)

***

—

***

An experiment is performed to study the formation
of images with lenses. In the diagram below, S is
a screen located 20 cm from the lens, L is a convex
(converging) lens, and O is an object located 100 m
from the lens. (The diagram is not to scale.)
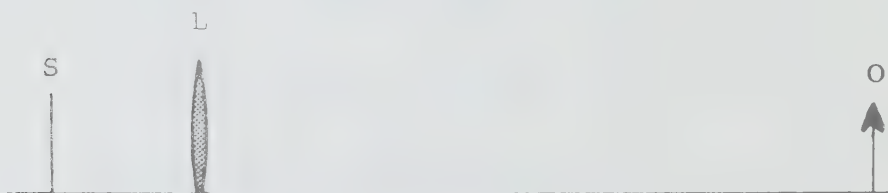
If a sharp image of O is formed at S, which one of
the following statements is <u>false</u>?

(A)   The focal length of the lens is approximately
      20 cm.

(B)   The image is inverted.

(C)   The image is smaller than the object.

(D)   The image is real.

(E)   If S is moved to the left, the image becomes
      erect.

16

S17A
II.3.b

S 297

A5
A1

(A)

***
—
***

As the distance of the object from a convex (converging) lens decreases from three to two focal lengths, the image

(A) increases in size and moves away `from the lens

(B) increases in size and moves toward the lens

(C) decreases in size and moves away from the lens

(D) decreases in size and moves toward the lens

(E) increases in size and changes from real to virtual

17

S17A
II.3.b

S 297

F1
A8

(E)

***
—
***

The double convex (converging) lens shown below has a focal length of 4.0 cm. An object 0 is located 2.0 cm outside focal point F_1. The real image formed is 3.0 cm high.
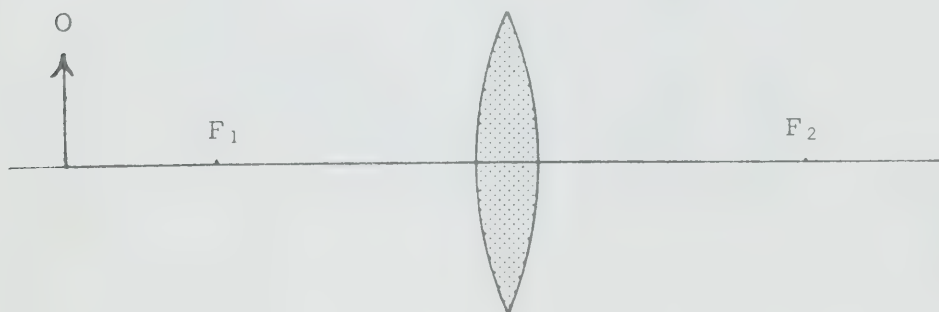
Where is the image located with reference to focal point F_2?

(A) 1.0 cm inside F_2

(B) 1.0 cm outside F_2

(C) 2.0 cm outside F_2

(D) 4.0 cm outside F_2

(E) 8.0 cm outside F_2

18

S17A
II.3.b

S 297

F1
A8

(B)

***
–
***

A double convex (converging) lens, whose focal length is 8.0 cm, has an object standing 4.0 cm from the focal point. The image formed is real and 12 cm high.

What is the height of the object?

(A)   3.0 cm

(B)   6.0 cm

(C)   8.0 cm

(D)   16 cm

(E)   24 cm

19

S17A
II.3.b

S 297

F1
A8

(B)

***
–
***

The focal length of a convex (converging) lens is 10 cm. The image of an object placed 30 cm from the lens will be

(A)   real and enlarged

(B)   real and reduced

(C)   real and the same size

(D)   virtual and enlarged

(E)   virtual and reduced

20

S17A
II.3.c

298

A2

(E)

***
–
***

The part of the eye that most closely corresponds to the film in the camera is the

(A)   cornea

(B)   iris

(C)   optic nerve

(D)   pupil

(E)   retina

21   What part of the eye corresponds most closely to
              the film in the camera?

S17A

II.3.c   (A)   retina

298   (B)   iris

A2   (C)   cornea

(A)   (D)   blind spot

**   (E)   optic nerve
-
**

22   The change in shape of the lens in the eye to form
              a sharp image is called

S17A

II.3.c   (A)   accommodation

S 298   (B)   astigmatism

A2   (C)   hypermetropia

(A)   (D)   iris reflex

***   (E)   myopia
-
***

1

S17A
II.3.a

280

A1
A8

(B)

**
—
***

When viewed from the shore, a fish which is some distance below the surface of the water will seem to be farther below the surface than it really is.

(A)   True

(B)   False

2

S17A
II.3.a

283

A2
A8
A11

(A)

*
—
**

The diagram represents a ray of light travelling from one material S to another material T.   Both S and T are transparent.
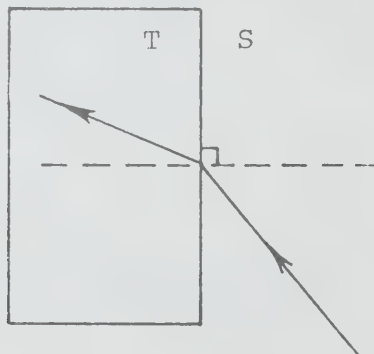
If the materials are air and glass, then T must be glass.

(A)   True

(B)   False

3

S17A
II.3.a

283

A2
A8
A11

(B)

**

-

***

The diagram represents a ray of light travelling from one material S to a second material T. Both S and T are transparent.
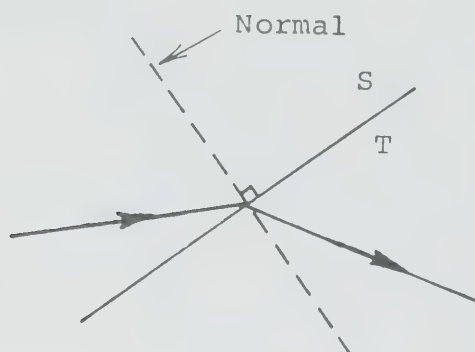
If the materials are air and glass, then S must be glass.

(A) True

(B) False

4

S17A
II.3.a

283

A2
A8
A11

(B)

**

-

**

The diagram represents a ray of light travelling from one material S to a second material T. Both S and T are transparent.
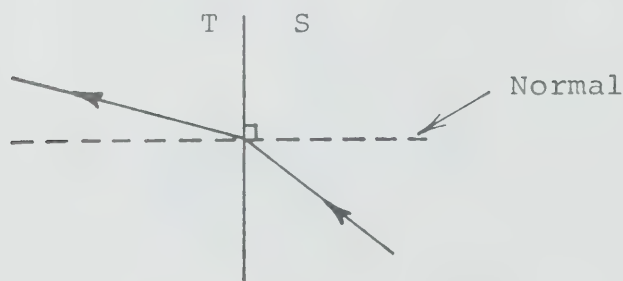
If the materials are air and glass, then S must be glass.

(A) True

(B) False

5

S17A
II.3.a

283

A2
A8
All

(A)

**

–

**

The diagram represents a ray of light travelling from one material S to a second material T.   Both S and T are transparent.
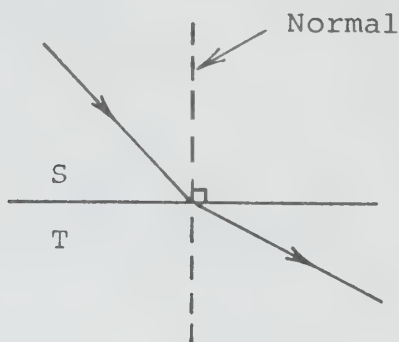
If the materials are air and glass, then S must be glass.

(A)   True

(B)   False

6

S17A
II.3.a

283

A2
A8
All

(B)

***

–

***

The diagram represents a ray of light travelling from one material S to another material T.   Both S and T are transparent.

If the materials are diamond and glass, then T must be glass.

(A)   True

(B)   False

7

S17A
II.3.a

283

A2
A8
A11

(A)

**
–
**

The diagram represents a ray of light travelling from one material S to another material T. Both S and T are transparent.
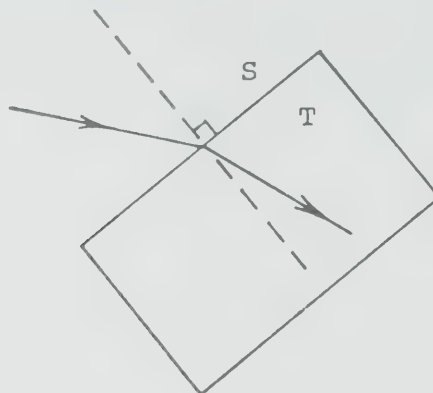
The angle of refraction is less than the angle of incidence.

(A)   True

(B)   False

8

S17A
II.3.a

283

A2
A8
A11

(B)

**
–
***

The diagram represents a ray of light travelling from one material S to another material T. Both S and T are transparent.
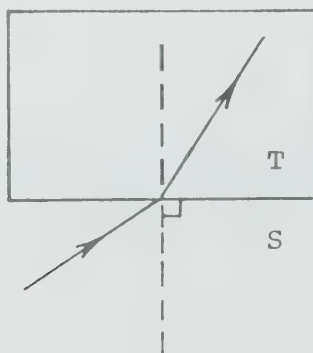
The angle of refraction is greater than the angle of incidence.

(A)   True

(B)   False

9

S17A
II.3.a

283

A8
A2

(A)

***
—
***

As light enters diamond from air at an angle of
incidence greater than zero, the angle of refraction
is less than the angle of incidence.

(A)   True

(B)   False

10

S17A
II.3.a

283

A8
A2

(B)

***
—
***

As light travels from air to water with an angle of
incidence greater than zero, the angle of refraction
is greater than the angle of incidence.

(A)   True

(B)   False

11

S17A
II.3.a

283

A8
A2

(B)

**
—
**

If the refracted ray is closer to the normal than
the incident ray, the angle of incidence is smaller
than the angle of refraction.

(A)   True

(B)   False

12

S17A
II.3.a

283

A8
A2

(A)

***
–
**

When light passes from air into a clear plastic block at an angle of incidence other than zero, the angle of incidence is always larger than the angle of refraction.

(A)   True

(B)   False

13

S17A
II.3.a

283

A8
A2

(A)

**
–
**

As light passes from air into water at an angle of incidence other than zero, the light is refracted toward the normal.

(A)   True

(B)   False

14

S17A
II.3.a

S 285

A1
A8

(A)

**
–
**

When light passes from clear plastic into air, the speed of the light will increase.

(A)   True

(B)   False

15

S17A
II.3.a

S 285

A8
A2

(B)

**

-

**

When light increases its speed at an interface, the angle of refraction is smaller than the angle of incidence.

(A)   True

(B)   False

16

S17A
II.3.a

286

A2

(A)

**

-

**

The critical angle is the angle of incidence for which the angle of refraction is equal to 90°.

(A)   True

(B)   False

17

S17A
II.3.a

286

A2

(B)

***

-

***

The critical angle is the angle of refraction for which the angle of incidence is equal to 90°.

(A)   True

(B)   False

18

S17A
II.3.a

286

A2

(A)

***
–
***

The critical angle for light going from glass to air
is the angle of incidence for which the angle of
refraction is 90°.

(A)   True

(B)   False

19

S17A
II.3.a

286

A3

(B)

***
–
***

If the diagram represents total internal reflection
of a light beam in a transparent material, then
material S must have a smaller index of refraction
than that of material T.

(A)   True

(B)   False

20   If light travelling through glass strikes an
                 interface with air at an angle of incidence less
S17A   than the critical angle for glass, total internal
II.3.a   reflection will occur.

286   (A)   True

A3   (B)   False
A2

(B)

**
—
***

21   Light, travelling upwards through water and striking
                 the boundary between the water and air at an angle
· S17A   of incidence greater than the critical angle, will
II.3.a   be reflected.

286   (A)   True

A3   (B)   False
A2

(A)

**
—
**

22   Light, travelling upwards through water and striking
                 the boundary between the water and air at an angle
S17C   of incidence greater than the critical angle, will
II.3.a   be reflected back along its incident path.

286   (A)   True

A3   (B)   False
A2

.(B)

**
—
**

OPTICAL INSTRUMENTS

1

S17A
II.3.c

299

A1

(C)

***
-
***

Which instrument makes use of one double convex (converging) lens with the object located slightly inside the focal point?

(A)   camera

(B)   compound microscope

(C)   magnifying glass

(D)   overhead projector

(E)   telescope

2

S17A
II.3.a

S 299

A1
A2

(C)

***
-
***

A virtual image is <u>always</u> formed by

(A)   an eye

(B)   a slide projector

(C)   a convex mirror

(D)   a camera

(E)   a convex lens

3

S17A
II.3.c

301

A1
A2

(A)

***
-
***

To overcome the defect of nearsightedness in the eyes, glasses must be used which have

(A)   diverging lenses

(B)   converging lenses

(C)   double convex lenses

(D)   bifocal lenses

(E)   plano convex lenses

·4

S17A
II.3.c

S 301

A1
A11

(D)

***
-
***

Light from a distant object focuses in front of the retina of an eye, as shown in the diagram.

retina
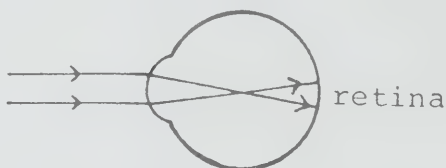
Which lens is used to correct this eye problem?

(A)   (B)   (C)

(D)   (E)

5

S17A

II.3.c

302

A1

(D)

***

—

***

Consider the following statements concerning the compound microscope.

    I.   The images formed by both the objective and the eyepiece are virtual and inverted.

    II. The objective lens has a short focal length.

    III. The eyepiece is used as a simple magnifying glass.

    IV. The objective is a convex lens, but the eyepiece is a concave lens.

Which two of the above statements are correct?

(A) I and II

(B) I and III

(C) I and IV

(D) II and III

(E) II and IV

6

S17A

II.3.c

S 302

F1

A1

A2

(B)

***

—

***

Suppose that f_O is the focal length of the objective lens of a compound microscope, and f_e is the focal length of the eyepiece. When the microscope is properly focused, the object on the microscope slide

(A) is less than f_O away from the objective lens

(B) is more than f_O away from the objective lens

(C) produces an intermediate image which is more than f_e away from the eyepiece

(D) produces an intermediate image which is more than $2f_e$ away from the eyepiece

(E) produces an intermediate image which is less than f_O away from the objective

1

S17A
II.3.c

299

A2
A1

(A)

**
--
**

A converging (convex) lens may be used as a magnifying glass if the object is placed at a distance of less than one focal length from the lens.

(A) True

(B) False

2

S17A
II.3.c

301

A1
A2

(B)

***
--
***

A nearsighted eye requires a converging (convex) lens to correct for this vision defect.

(A) True

(B) False

3
--
S17A
II.3.c

302

A1
A2

(A)

**
--
**

In a compound microscope, the focal length of the objective lens is less than the focal length of the eyepiece.

(A) True

(B) False

COLOUR

THE SPECTRUM

1

S17A
II.3.a

309

B1
A11

(B)

***
-
***

Which one of the following diagrams correctly shows the dispersion of white light by a triangular prism?

(A)

(B)

(C)

(D)

(E)

2

S17A
II.3.a

314

A2
A11

(A)

***
—
***
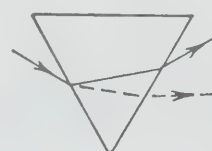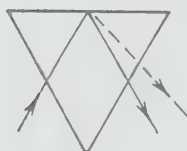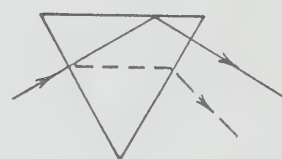
A ray of light passes through a glass prism. In which of the following diagrams is the angle of deviation correctly labelled by the angle ϕ.

(A)

(B)

(C)

(D)

(E)
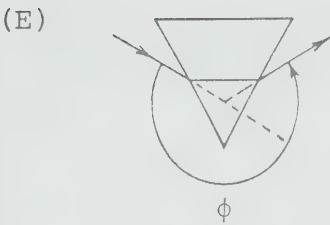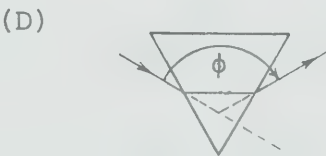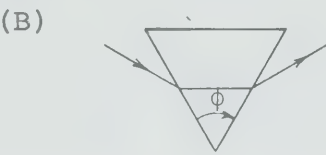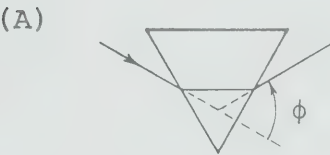
COLOUR AND

COLOUR-MIXING

1

S17A
II.3.a

318

A1

(A)

***
−
***

Beams of blue, green and red light of equal intensity
are incident on the same spot on a screen at the same
time. Their combined colour is

(A) white

(B) yellow

(C) black

(D) brown

(E) violet

2

S17A
II.3.a

324

A2

(D)

**
−
**

A white ceiling aids in the illumination of a room
because of

(A) absorption

(B) diffusion

(C) refraction

(D) reflection

(E) transmission

3

S17A
II.3.a

325

A8

(E)

**

—

**

Pure yellow light falls upon a sheet of white paper ruled with blue lines. As a result

(A)   both the paper and blue lines appear black

(B)   the paper appears white and the lines black

(C)   the paper appears yellow and the lines invisible

(D)   both the paper and the lines appear yellow

(E)   the paper appears yellow and the lines black

4

S17A
II.3.a

325

A8
F3

(A)

***

—

***

Some modern highways are illuminated with yellow sodium lights. What colour will a pure blue automobile appear to be on such a highway at night?

(A)   black

(B)   blue

(C)   brown

(D)   green

(E)   white

5

S17A
II.3.a

325

F1
A8

(D)

***

—

***

If you look at a pure blue dress under a pure red light, the dress is likely to appear

(A)   blue

(B)   red

(C)   bluish-red

(D)   black

(E)   violet

INFRARED AND

ULTRAVIOLET RADIATION

1

S17C

II.6.a

338

.

A5

A2

(B)

***

-

***

Ultraviolet radiation has a longer wavelength than does visible light.

(A)   True

(B)   False

FLUIDS

FLUIDS AT REST

1   Which one of the following is the correct SI symbol
            for the unit of pressure?

340   (A)   pa

A2   (B)   pa.
A11
            (C)   pA
(D)
            (D)   Pa
***
-           (E)   Pa.
***

2   Four materials are listed below:

                    I.   air

                    II. molasses
S 340
                    III. alcohol
A2
                    IV. paper
(D)
            The term 'fluid' would include:
***
-           (A)   I and II only
***
            (B)   I and III only

            (C)   II and III only

            (D)   I, II and III only

            (E)   I, II, III and IV

3

S 341

A ballerina stands on the tips of the toes of
both feet. If the mass of the girl is 40 kg and
the <u>total</u> area of the tips of her toes is
1.0×10^{-3} m^2, how much pressure does she exert
on the floor? (g = 10 N/kg)

F1
A8

(C)

***
-
***

(A)   4.0 kPa

(B) 4.0×10^1 kPa

(C) 4.0×10^2 kPa

(D) 4.0×10^2 Pa

(E) 8.0×10^2 kPa

4

344

A hydraulic press has one piston with radius 5.0 cm
and the other with radius 15 cm. If a force of
600 N is applied to the smaller piston, the force
exerted on the larger piston will be

F1
A8

(E)

***
-
***

(A) 6.7×10^1 N

(B) 2.0×10^2 N

(C) 6.0×10^2 N

(D) 1.8×10^3 N

(E) 5.4×10^3 N

5

Atmospheric pressure at sea level is approximately
equal to

S 347

A1

(E)

***
-
***

(A)   1 Pa

(B)   1 kPa

(C)   10 kPa

(D)   100 Pa

(E)   100 kPa

1

For an inflated car tire, the absolute pressure is greater than the gauge pressure.

(A)   True

348

(B)   False

A2
A1

(A)

***
–
***

FLUIDS IN MOTION

1   When a fluid such as water passes through a
        constriction, the fluid's

362   (A)   speed increases and lateral pressure decreases
340   (B)   speed increases and lateral pressure stays
              constant
A1
A8   (C)   speed increases and lateral pressure increases

(A)   (D)   speed decreases and lateral pressure increases

***   (E)   speed decreases and lateral pressure decreases
-
***

2   Three physical quantities are given below:

                I.   energy

                II. pressure
S 362
                III. velocity
A8
        Which of these quantities would be needed to
(E)   understand Bernoulli's Principle?

***   (A)   I only
-
***   (B)   II only

        (C)   III only

        (D)   II and III only

        (E)   I, II and III

3   Bernoulli's Principle states that

           (A)   a fluid moves from a high pressure to a low
                 pressure region.

S 362   (B)   a fast moving fluid has more energy than a
                 slow moving fluid.
A8
           (C)   a fast moving fluid exerts less sideways
(C)   pressure than a slow moving fluid.

***   (D)   a fast moving fluid exerts more sideways
-                pressure than a slow moving fluid.
***
           (E)   a fast moving fluid has a lower density than
                 a slow moving fluid.

4   In a fluid, the Bernoulli effect may be observed
           when there is a difference in _____ at two points
           near each other.

           The word or phrase which correctly completes the
S 362   above statement is

A8   (A)   density

(C)   (B)   direction of flow

           (C)   speed

           (D)   streamlining

           (E)   turbulence

5   In fluids the Bernoulli effect may be observed when,
           at two points near each other, there is a difference
           in

           (A)   velocity
S 362
           (B)   density
A8
           (C)   streamlining
(A)
           (D)   turbulence
***
-          (E)   direction of flow
***

1   The faster a fluid moves past a point in a tube, the
            greater the pressure the fluid exerts on the walls
            of the tube.

362   (A)   True

A8   (B)   False
A2

(B)

***
-
***

THERMAL EFFECTS

TEMPERATURE

1   In SI, room temperature is about twenty degrees on
          the

          (A)   absolute scale

S 368
          (B)   Celsius scale

A2
          (C)   centigrade scale

(B)
          (D)   Fahrenheit scale

*
-         (E)   Kelvin scale
**

HEAT

1   Which of the following statements shows <u>incorrect</u>
            usage of the term heat?

            (A)   A radiator gives off heat to the room.

370   (B)   A frying pan conducts heat to the egg.

A1   (C)   Heat rises up the chimney by convection.
A2   \

            (D)   The heat of the water is ninety degrees Celsius.
(D)

            (E)   A heat pump moves heat from one place to another.
**
—
***

CALORIMETRY

1

376

A2

(E)

***

−

***

If the same amount of heat energy is supplied without loss to two different substances of equal mass, their final temperatures may be different because they have different

(A) abilities to conduct heat

(B) coefficients of expansion

(C) densities

(D) volumes

(E) specific heat capacities

2

S 376

F1
A8

(D)

***

−

***

How much heat is needed to raise the temperature of 20 g of water 5.0°C?   [c = 4 200 J/(kg·°C)]

(A) 5.0 J

(B) 2.0 x 10^1 J

(C) 1.0 x 10^2 J

(D) 4.2 x 10^2 J

(E) 4.2 x 10^5 J

3   Which one of the following is a correct definition
           of specific heat capacity?

           (A)   the quantity of heat given off by the complete
                  combustion of 1 kg of a substance

S 377
           (B)   the quantity of heat needed to raise the
A2   temperature of 1 kg of a substance 1°C

(B)   (C)   the quantity of heat needed to raise the
                  temperature of 1 kg of a substance from 0°C
**   to 100°C
-
***   (D)   the quantity of heat needed to melt 1 kg of a
                  substance without a temperature change

           (E)   the quantity of heat needed to vapourize 1 kg
                  of a substance without a temperature change

4   The heat capacity of an object is defined as

           (A)   the amount of heat energy to raise its
                  temperature by 1°C

S 377   (B)   the amount of heat energy needed to change
                  its state without changing its temperature
A2
           (C)   the amount of heat energy per kilogram to
(A)   raise its temperature by 1°C

***   (D)   the ratio of its specific heat capacity to
-                 that of water
***
           (E)   the change in temperature produced by the
                  addition of 1 J of heat energy

5   If the specific heat capacity of aluminum is
         900 J/(kg·°C), the heat energy required to increase
         the temperature of 10.0 g of aluminum from 15°C to
         20°C is

S 377   (A) 4.5×10^1 J

F1   (B) 1.4×10^2 J
A8
             (C) 1.8×10^2 J
(A)
             (D) 3.2×10^2 J
***
−   (E) 4.5×10^4 J
***

6   A student does an experiment using the method of
         mixtures to determine the specific heat capacity of
         a metal.   The specific heat capacity of water is
         known.   The student obtained the following data:

379   mass of metal   240 g

D1   mass of water   389 g
F1
                 mass of calorimeter and   290 g
(E)   stirrer

***   specific heat capacity of   900 J/(kg·°C)
−   calorimeter and stirrer
***
                temperature change of water   4.0°C

                temperature change of metal   80°C

         What additional data, if any, does the student need
         before proceeding with the calculations?

         (A)   the initial temperature of the water

         (B)   the initial temperature of the calorimeter and
               stirrer

         (C)   the initial temperature of the metal

         (D)   the final temperature of the water

         (E)   No additional data is needed.

7   A student knows the specific heat capacity of water
               from previous experiments. During the laboratory
               determination of the specific heat capacity of a
               metal by the method of mixtures, the student measures
               the following:

S 379
                    I.   the mass of cold water in a cup
A7
                    II. the initial and final temperature
(C)   of the water in the cup

***   III. the mass of the metal
-
***   What additional measurement is needed to determine
               the specific heat capacity of the metal?

               (A)   the volume of cold water in the cup

               (B)   the final temperature of the metal sample

               (C)   the initial temperature of the metal sample

               (D)   the mass of the boiling water

               (E)   the specific heat capacity of the water

1   The specific heat capacity of common substances is
            defined as the energy to change the state of a
            substance.

            (A)   True

378
S 376   (B)   False

A2
A1

(B)

2   The specific heat capacity of common substances is
            defined as the number of joules of heat energy in
            a substance.

            (A)   True

378
S 376   (B)   False

A2
A1

(B)

3   The specific heat capacity of common substances is
            defined as the number of joules of heat energy in
            a kilogram of a substance.

            (A)   True

378
S 376   (B)   False

A2
A1

(B)

4   The specific heat capacity of common substances is
            the same at the same temperature and pressure.

            (A)   True

378   (B)   False
S 376

A2
A1

(B)

STATICS

MACHINES

1

A balanced lever is constructed as shown.

393

Fl
A8

(E)
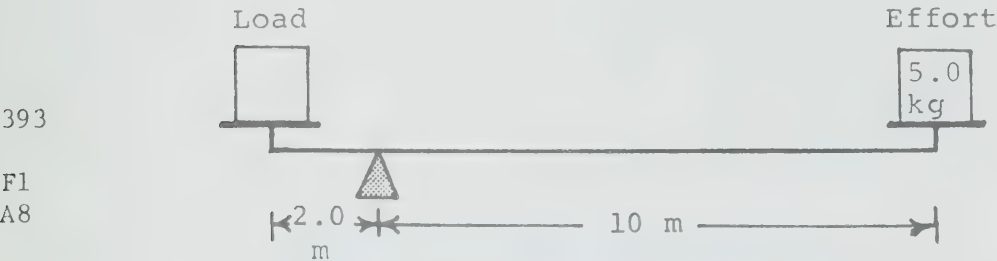
The force of gravity on the load is

***
–
***

(A)   5.0 kg

(B)   25 kg

(C)   50 N

(D)   100 N

(E)   250 N

2

A lever balance is constructed as shown.

393
390

Fl
A8

(D)
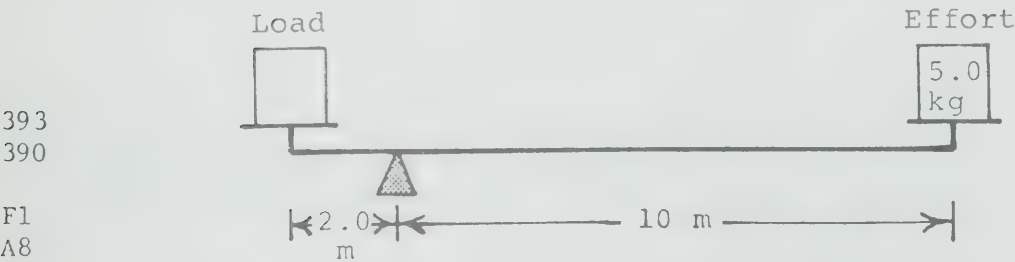
The mechanical advantage of this machine is

***
–
***

(A)   0.20

(B)   0.50

(C)   2.0

(D)   5.0

(E)   20

3   A labourer using a first class lever places the load the same distance from the fulcrum as the effort. If the fulcrum is moved closer to the load, the mechanical advantage of the machine

391   (A)   increases

F1   (B)   decreases
A2

(C)   remains the same
(A)

(D)   approaches one
**

–   (E)   approaches zero
***

4   A labourer applies a force of 25 N at a distance of 4.0 m from the fulcrum of a first class lever to raise a load of 100 N. What is the mechanical advantage of the lever?

395   (A)   4.0

F1   (B)   2.0
A8

(C)   1.0
(A)

(D)   0.50
***

–   (E)   0.25
***

5   A labourer applies a force of 25 N at a distance of 4.0 m from the fulcrum of a first class lever to raise a load of 100 N. How far is the load from the fulcrum?

S 395   (A)   0.25 m

F1   (B)   1.0 m
A8

(C)   2.0 m
(B)

(D)   4.0 m
***

–   (E)   16 m
***

RADIOACTIVITY

AND

RADIATION EXPOSURE

RADIOACTIVITY

1   The number of protons in $^{7}_{3}Li$ is

S17A   (A)   3
IV.2.f
            (B)   4
397
            (C)   7
F1
A4   (D)   10

(A)   (E)   none of the above

***
--
***

2   The number of neutrons in $^{7}_{3}Li$ is

S17A   (A)   3
IV.2.f
            (B)   4
397
            (C)   7
F1
A4   (D)   10

(B)   (E)   none of the above

***
--
***

3

S17A
IV.3.a

S 397

F1
A2

(E)

***
—
***

Nonradioactive sodium $^{23}_{11}Na$ can be converted into radioactive sodium $^{24}_{11}Na$ by bombardment with

(A)   alpha particles

(B)   beta particles

(C)   electrons

(D)   protons

(E)   neutrons

4

S17A
IV.3.b

398

A7

(B)

***
—
***

The separation of $^{235}_{92}U$ from the other isotopes of uranium requires a physical method rather than a chemical method because

(A)   it is dangerous to mix other chemicals with uranium

(B)   all isotopes of uranium have the same chemical properties

(C)   all isotopes of uranium are radioactive

(D)   uranium is the heaviest element in nature

(E)   natural uranium contains only a very small percentage of $^{235}_{92}U$

5

S17A
IV.3.a

399

A2
A11

(B)

***
—
***

The nuclear reaction $^{24}_{11}Na \longrightarrow {}^{24}_{12}Mg + {}^{0}_{-1}e + Energy$ is an example of

(A)   alpha decay

(B)   beta decay

(C)   gamma decay

(D)   nuclear fission

(E)   nuclear fusion

6

The isotope $^{16}_{8}O$ will be changed to an isotope of a different element if it

S17A
IV.3.a

(A)   emits a gamma photon

399

(B)   absorbs a neutron

A5
A11

(C)   emits a negative beta particle

(C)

(D)   absorbs a light photon

(E)   becomes ionized

***
-
***

7

An atom is radioactive if

S17A
IV.2.c

(A)   its nucleus is unstable

S 399

(B)   the orbital electrons are easily lost

A2

(C)   it gains electrons readily

(A)

(D)   it is easily ionized

**
-
***

(E)   it is chemically active

8

Natural radioactivity was first discovered by

S17A
IV.2.c

(A)   Becquerel

S 399

(B)   Curie

I3

(C)   Einstein

(A)

(D)   Roentgen

***
-
***

(E)   Thomson

9

S17A
IV.2.c

400

A5
A2

(A)

***
—
***

When an atom of a radioactive substance gives off a beta particle, it changes to

(A) the atom of another element with the same mass number

(B) the atom of another element with a smaller mass number

(C) the atom of another element with a larger mass number

(D) another form of the same element, but with one beta particle less in the nucleus

(E) another form of the same element, but with one neutron less in the nucleus

10

S17A
IV.3.a

401

A2
A11

(B)

***
—
***

If $^{28}_{13}$Al gives off a gamma ray, the remaining nucleus is

(A) $^{28}_{14}$Si

(B) $^{28}_{13}$Al

(C) $^{27}_{13}$Al

(D) $^{24}_{11}$Na

(E) $^{27}_{12}$Mg

11

S17A
IV.2.c

402

A1
A2

(D)

***
—
**

The most penetrating emissions given off by naturally radioactive substances are

(A) alpha particles

(B) beta particles

(C) cosmic rays

(D) gamma rays

(E) neutrons

12

S17A
IV.2.c

S 403

F3
A2

(B)

**

–

***

Safety regulations in Canada make it mandatory that
all colour TV sets have protective shields built
into their picture tubes (which are cathode ray
tubes). This regulation is necessary because the
cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   cause the picture tube to degenerate

13

S17A
IV.1.c

404

A1
A2

(B)

***

–

***

This question involves two statements:

    I.   X rays cannot be deflected by a
          magnetic field.

    II.   X rays travel at the speed of light.

Which of the following responses correctly describes
the two statements?

(A)   Both statements are true and one statement can
       be used to explain the other.

(B)   Both statements are true, but neither statement
       can be used to explain the other.

(C)   Statement I is true.
       Statement II is false.

(D)   Statement I is false.
       Statement II is true.

(E)   Statement I is false.
       Statement II is false.

14

S17A
IV.2.c

S 404

E2
A2

(B)

**

–

***

Experiments show that photographic film wrapped in black paper becomes exposed when it is placed near a cathode ray tube. The most reasonable inference from this observation is that cathode rays

(A)   possess kinetic energy

(B)   produce X rays

(C)   travel in straight lines

(D)   carry a charge

(E)   travel at the speed of light

15

S17A
IV.2.c

S 404

I3
A2
A7

(E)

***

–

***

Natural radioactivity was first detected by means of

(A)   magnetic fields

(B)   a cloud chamber

(C)   an electroscope

(D)   a Geiger counter

(E)   photographic film

16

S17A
IV.2.c

405

A1
A2

(E)

***

***

Gamma rays are most similar to

(A)   alpha particles

(B)   beta particles

(C)   cosmic rays

(D)   light rays

(E)   X rays

17   The emission of gamma radiation from the nucleus

S17A   (A)   changes the atomic number, but not the mass
IV.2.c   number

S 405   (B)   changes the mass number, but not the atomic
                    number
A1
A2   (C)   carries away excess energy without involving
                    a transmutation
 (C)
              (D)   is accompanied by the emission of a beta
***   particle
_
***   (E)   is accompanied by the emission of an alpha
                    particle

18   Alpha particles are

S17A   (A)   positively charged hydrogen nuclei
IV.2.c
              (B)   negatively charged hydrogen nuclei
406
              (C)   negatively charged electrons
A2
              (D)   positively charged protons
 (E)
              (E)   none of the above
***
_
***

19   When an alpha particle is emitted by the atom of a
              radioactive substance
S17A
IV.3.a   (A)   the atomic number is reduced by 4 and the mass
                    number is reduced by 2
S 406
              (B)   the atomic number is increased by 1 and the
A5   mass number stays unchanged
A2
              (C)   the atom is changed to an isotopic form of the
 (E)   same element

***   (D)   the atom is changed to the atom of a heavier
_   element
***
              (E)   None of the above changes occur.

20

S17A

IV.2.d

S 406

I3

(D)

***
-
***

Which of the following scientists first demonstrated the production of artificial radioactivity?

(A)   Becquerel

(B)   Curie

(C)   Roentgen

(D)   Rutherford

(E)   Thomson

21

S17A
IV.2.c

407

A1
A2

(A)

***
-
***

An alpha particle is a

(A)   helium nucleus

(B)   hydrogen ion

(C)   negative particle

(D)   positive electron

(E)   radioactive element

22

S17A
IV.2.c
S17C
IV.5.a

407

B4
A7

(B)

***
-
***

The nature of the electric charge on an alpha particle could best be determined by using

(A)   a voltmeter and an ammeter

(B)   an electromagnet and a cloud chamber

(C)   a galvanometer and a coil of wire

(D)   a compass and a Geiger counter

(E)   a glass rod and a silk cloth

23   Alpha particles discharge a charged electroscope by

S17A   (A)   causing water vapour to form around the electro-
IV.2.c   scope

407   (B)   making the air around the electroscope radio-
                  active
F1
A8   (C)   adding their negative charge to the electroscope

(D)   (D)   ionizing the air around the electroscope

***   (E)   attracting protons from the electroscope
-
***

24   The nuclear reaction $^{210}_{84}Po \longrightarrow\ ^{206}_{82}Pb + ^{4}_{2}He$ + energy
            is an example of
S17A
IV.3.a   (A)   alpha decay

408   (B)   beta decay

A2   (C)   gamma decay
A5
A11   (D)   nuclear fission

(A)   (E)   nuclear fusion

***
-
***

25   If $^{230}_{90}Th$ gives off an alpha particle, the atomic
            number of the remaining nucleus is
S17A
IV.3.a   (A)   229

408   (B)   228

F1   (C)   90
A3
A2   (D)   89

(E)   (E)   88

***
-
***

26

S17A
IV.3.a

408

F1
A3
A2

(A)

***
—
***

If $^{230}_{90}$Th gives off an alpha particle, the atomic number of the remaining nucleus is

(A)   88

(B)   89

(C)   90

(D)   91

(E)   92

27

S17A
IV.3.b

S 408

A1

(B)

***
—
***

Natural uranium contains about 0.7% of

(A) $^{234}_{92}$U

(B) $^{235}_{92}$U

(C) $^{236}_{92}$U

(D) $^{238}_{92}$U

(E) $^{239}_{92}$U

28

S17A
IV.3.b

S 408

A1

(B)

What percentage of $^{235}_{92}$U is contained in naturally occurring uranium?

(A)   0.07%

(B)   0.7%

(C)   7%

(D)   93%

(E)   99.3%

29

S17A
IV.3.b

S 408

A5
A2

(B)

***
-
***

The substance remaining after uranium has finished
its series of disintegrations is

(A)   carbon

(B)   lead

(C)   polonium

(D)   radium

(E)   thorium

30

S17A
IV.3.a

411

D3
A2

(B)

***
-
***

The decay curve for a radioactive substance is shown
in the graph below.
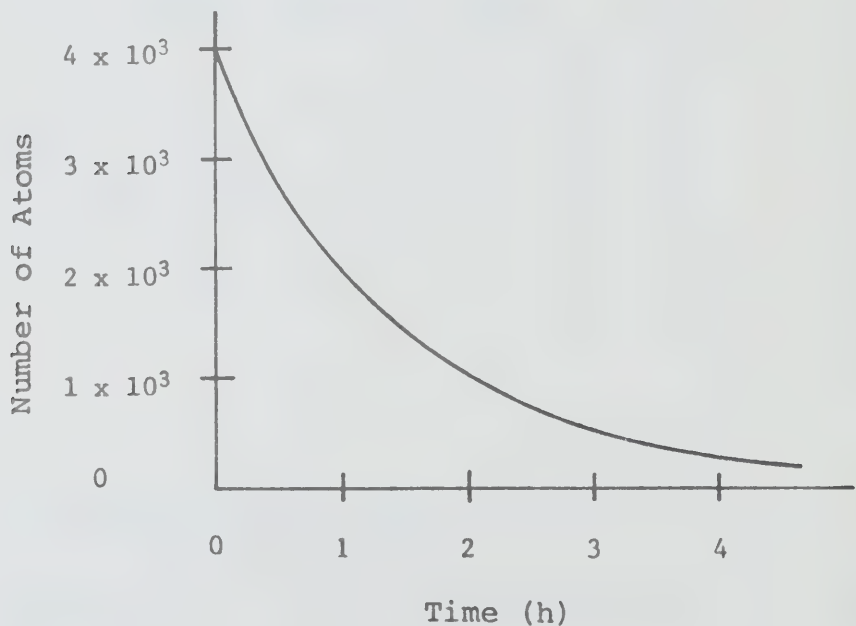
The half life of this substance is

(A)   ½ h

(B)   1 h

(C)   2 h

(D)   3 h

(E)   4 h

31

S17A
IV.3.a

411

F1
A2

(E)

***
-
***

The half life of polonium is 140 d. How many days would it take for a sample of polonium to lose three-quarters of its original activity?

(A)   35

(B)   105

(C)   186.7

(D)   210

(E)   280

32

S17A
IV.3.a

411

F1
A2

(D)

***
-
***

At the end of 14 min, 1/16 of a sample of polonium remains. The half life of polonium is therefore

(A) $\frac{7}{8}$ min

(B) $\frac{8}{7}$ min

(C) $\frac{7}{4}$ min

(D) $\frac{7}{2}$ min

(E) $\frac{14}{3}$ min

33

S17A
IV.3.a

S 413

A5
A2

(D)

***
-
***

The half life of a certain radioactive material is 7 d. The percentage of the original material remaining after 14 d will be

(A)   93%

(B)   86%

(C)   50%

(D)   25%

(E)   0

34

S17A
IV.3.a

S 413

F1
A2

(C)

***
—
***

The half life of a radioactive isotope A is 6.5 h. If there are initially 48×10^{32} atoms of A, the number of radioactive atoms of A after 26 h is

(A) 12×10^{32}

(B) 6×10^{32}

(C) 3×10^{32}

(D) 6×10^4

(E) 3×10^2

1

S17A
IV.2.f

397
135

A4
A2

(A)

***
–
***

There are six neutrons in the nucleus of the element $^{11}_{5}B$.

(A)   True

(B)   False

2

S17A
IV.3.a

399

A5
A2

(A)

**
–
**

When the nucleus of an atom emits a negative beta-particle, its atomic number is increased by one.

(A)   True

(B)   False

3

S17A
IV.3.a

399

A5
A2

(A)

***
–
***

When the nucleus of an atom emits a negative beta-particle, its mass number remains unchanged.

(A)   True

(B)   False

4

S17A
IV.2.c

403

A2
A5

(A)

**

—

***

X rays are emitted by a metal target when it is struck by high-velocity electrons.

(A) True

(B) False

5

S17A
IV.2.c

405

A2

(B)

**

—

**

X rays originate in the nucleus of an atom.

(A) True

(B) False

6

S17A
IV.2.c

S 405

A1
A2

(B)

The emission of gamma radiation from the nucleus changes the atomic number, but not the mass number.

(A) True

(B) False

7

S17A
IV.2.c

S 405

A1
A2

(B)

The emission of gamma radiation from the nucleus changes the mass number, but not the atomic number.

(A)   True

(B)   False

8

S17A
IV.2.c

S 405

A1
A2

(A)

The emission of gamma radiation from the nucleus carries away excess energy without involving a transmutation.

(A)   True

(B)   False

9

S17A
IV.2.c

S 405

A1
A2

(B)

The emission of gamma radiation from the nucleus is accompanied by the emission of a beta particle.

(A)   True

(B)   False

10

S17A
IV.2.c

S 405

A1
A2

(B)

The emission of gamma radiation from the nucleus is accompanied by the emission of an alpha particle.

(A)   True

(B)   False

11

S17A
IV.2.d

406

A2

(A)

***
–
***

An alpha particle is composed of two protons and two
neutrons.

(A)   True

(B)   False

12

S17A
IV.2.a

406

A2

(A)

***
–
***

The alpha particle is the same as the nucleus of a
helium atom.

(A)   True

(B)   False

13

S17A
IV.3.a

411

A2

(B)

**
–
**

The half-life of a radioactive substance is half the
life-span of the substance.

(A)   True

(B)   False

RADIATION EXPOSURE

1

S17A
IV.4.a

414

A1
B3

(A)

**
-
***

Which one of the following substances is useful in determining the age of archaeological samples?

(A)   carbon 14

(B)   cobalt 60

(C)   plutonium 239

(D)   radium 224

(E)   uranium 235

2

S17A
IV.2.c

S 414

F1
A2

(E)

***
-
***

Pitchblende, an ore containing uranium, also always contains thorium, radium and lead among other elements.   This is because these elements

(A)   belong to the same family of elements

(B)   are near each other in the periodic table

(C)   are transuranic elements

(D)   are chemically unstable

(E)   are formed by the transmutation of uranium

3

S17A
IV.3.b

S 414

I5

(D)

**

–

**

From the list below select the most valid argument
against the use of nuclear fission to generate
electricity for Ontario.

(A)   Energy conservation offsets increasing demands
      for electricity.

(B)   Decreasing birth rates forecast decreased
      demands for electricity.

(C)   Solar energy is supplying a significant portion
      of our electricity.

(D)   There is the possibility of a major nuclear
      accident.

(E)   New discoveries of oil will supply us with
      sufficient energy at low cost.

4

S17A
IV.3.b

S 414

I5

(C)

**

–

***

From the list below, select the best argument
against the sale of CANDU reactors to developing
countries.

(A)   It will discourage the development of their
      own technology.

(B)   Canada will no longer be able to sell them the
      electricity we produce.

(C)   It is difficult to police the use of fission
      products.

(D)   Canada will not have enough reactors for its
      own use.

(E)   Canada will not have enough uranium for its
      own use.

5

S17A
IV.4.a

S 418

F3
A1

(D)

***
—
***

Radioactive fallout levels are monitored by analyzing milk for radioactive

(A) calcium

(B) plutonium

(C) radon

(D) strontium

(E) uranium

6

S17A
IV.4.a

S 421

I3
A1

(A)

***
—
***

The cobalt bomb treatment for cancer was developed in

(A) Canada

(B) Denmark

(C) England

(D) Japan

(E) United States

ENERGY SOURCES

AND

CONSERVATION

ENERGY SOURCES

1

S17A
I.1.c

426

I5

(B)

***
-
***

Several forms of pollution are listed below. Which form of pollution from the Pickering nuclear reactors poses a threat to the local environment?

(A)   acid rain

(B)   heat

(C)   noise

(D)   smoke

(E)   sulphur dioxide

2

S17A
I.1.c

426

I5

(C)

**
-
**

From the list below select the most potentially dangerous form of pollution from the Pickering nuclear reactors.

(A)   acid rain

(B)   white noise

(C)   radioactive effluent

(D)   obnoxious sewage

(E)   sulphur dioxide

3

S17A
I.3.c

S 426

A2

(A)

*
-
*

Which of the following is a 'renewable' source of energy?

(A)   a waterfall

(B)   coal

(C)   natural gas

(D)   bitumen

(E)   uranium

4

S17C
I.1.c

426

I5

(B)

***
—
***

From the list below select the main detrimental impact to the environment of the Pickering nuclear reactors.

(A)   Noise from the reactor site is loud.

(B)   Large amounts of heat are released.

(C)   Chemicals from the reactor come back to earth as acid rain.

(D)   The plant sites are ugly.

(E)   Plant sites use land that is needed for farming.

5

S17A
I.3.c

S 426

A2

(D)

*
—
*

Which of the following is a 'renewable' source of energy?

(A)   coal

(B)   gasoline

(C)   natural gas

(D)   solar energy

(E)   uranium

6

S17A
I.3.c

S 426

A2

(E)

**
—
**

Which of the following is a 'renewable' source of energy?

(A)   coal

(B)   gasoline

(C)   natural gas

(D)   uranium

(E)   wood

1

S17A
I.3.c

424

F3
A2

(B)

*
—
*

The greenhouse effect in a solar house is an increase
in solar absorption when the solar panels are painted
green.

(A)   True

(B)   False

2

S17A
I.3.c

424

F3
A2

(A)

***
—
***

The greenhouse effect in a solar house is caused
because glass will not transmit infrared radiation.

(A)   True

(B)   False

3

424

F3
A3

(B)

The greenhouse effect in a solar house is caused by
a set of venting windows at the top of the house
which let out excess heat in summer.

(A)   True

(B)   False

4   The greenhouse effect in a solar house is the
           delivery of heat to the home from an adjacent
           greenhouse.

424   (A)   True

F3   (B)   False
A3

(B)

5   The greenhouse effect in a solar house is caused by
           water vapour that is produced by plants in the house.

           (A)   True
424
           (B)   False
F3
A3

(B)

HISTORICAL PERSPECTIVE

ASTRONOMY

THE UNIVERSE

1

S17C

III.3.a

444

B1

A2

(B)

***

—

***

The task of locating the planets in the night sky is simplified by the fact that they

(A)   appear near the moon

(B)   appear close to the ecliptic

(C)   do not exhibit diurnal motion

(D)   can be located by using "pointer" stars from the big dipper

(E)   are visible before midnight

GREEK SCIENTISTS

1

S17C
III.3.a

446

A1
I3

(B)

***
–
***

The concept of a universe with the earth not at the centre was first proposed by

(A)   Ptolemy

(B)   Aristarchus

(C)   Euclid

(D)   Copernicus

(E)   Aristotle

NEWTON AND BEYOND

1   Which of the following descriptions of a comet is
                    correct?   A comet is
S17C
III.3.a   (A)   a planet

478   (B)   a planetoid

A2   (C)   an asteroid

(E)   (D)   a meteorite

***   (E)   None of the above descriptions is correct.
_
***